DRAFT

GREAT LAKES BINATIONAL TOXICS STRATEGY

DRAFT MANAGEMENT ASSESSMENT

FOR

BENZO(A)PYRENE

US Environmental Protection Agency
Great Lakes National Program Office
Chicago, IL

&

Environment Canada

August 1, 2005

EXECUTIVE SUMMARY

INTRODUCTION

The Great Lakes Binational Toxics Strategy identifies specific challenge goals for each Level 1 substance for the U.S. and Canada, with a timeframe that expires in 2006. As 2006 approaches, an analysis of progress and determination of next steps is needed to respond to the mandate set forth in the Strategy. A *General Framework to Assess Management of GLBTS Level 1 Substances* was developed to provide a tool to assist the Parties (Environment Canada and US EPA) and stakeholders in conducting a transparent process to determine the appropriate management outcomes for the Level 1 substances. This report presents an analysis of benzo(a)pyrene (B(a)P) conducted using the general framework.

CHALLENGE GOAL STATUS

Both Canada and the US have made progress in achieving reductions of B(a)P. Canada has reduced releases in Ontario by approximately 45 percent, relative to a 1988 baseline, and continues to pursue the goal of a 90 percent reduction. However, it is unlikely that Canada will meet its reduction goal by 2006. Total B(a)P releases in Ontario are currently estimated at 29,000 lbs (13,200 kg) per year. The US has reduced B(a)P emissions in the Great Lakes Basin by approximately 77 percent from 1996 to 2001, thus achieving the goal of (unquantified) reductions. Current estimated B(a)P emissions in the US Great Lakes states are 43,700 lbs (19,900 kg) per year. However, the emission inventories for Ontario and the US need to be reviewed for completeness, consistency, and comparability with each other.

ENVIRONMENTAL ANALYSIS

In general, basinwide environmental data indicate that there has been little change in B(a)P concentrations in the Great Lakes over the past decade. However, a recent declining trend has been reported in Lake Erie bottom sediment, the only lake with available lakewide sediment data. B(a)P levels in Great Lakes soil and sediment exceed criteria while B(a)P levels in fish tissue, air, and water are below available criteria. Higher concentrations of B(a)P are found on Lakes Erie and Ontario than on the other Great Lakes, at sites near major population centers.

SOURCES OF B(a)P

Eighty percent of Ontario's anthropogenic B(a)P releases are primarily from non-point sources: residential wood combustion, use of creosote-treated wood products, motor vehicle emissions, and open burning (prescribed burning and household waste burning). The remaining twenty percent are from iron & steel cokemaking operations. Iron and steel cokemaking remains the largest B(a)P point source in Ontario in spite of major reduction efforts—emissions were reduced by 73 percent in 2002 relative to a 1988 base year.

The U.S. Great Lakes inventory is comprised of B(a)P emissions from residential wood combustion, cokemaking, and other sources. Since the 2001 inventory was prepared, emissions from coke ovens have been substantially reduced. Potential sources of B(a)P emissions not listed in the U.S. Great Lakes inventory include: forest and wildfires, residential burning of household waste, scrap tire fires, prescribed burning, and mobile sources. However, forest and

wildfires and prescribed burning occur mainly in the Western U.S. and may not contribute significantly to B(a)P levels in the Great Lakes Basin.

OPPORTUNITY ASSESSMENT

The GLBTS has identified a number of opportunities to effect reductions in B(a)P releases to the Great Lakes Basin. These include reducing or preventing B(a)P emissions from residential wood combustion, scrap tire fires, and residential burning of household waste, and gathering information on emissions from poorly characterized sources. Another important effort is to improve the current emission inventories for Ontario and the U.S. Great Lakes Basin, and especially to identify sources that are not included in the inventories.

MANAGEMENT OUTCOME

The impact of B(a)P is not specific to any one Great Lake, though concentrations are higher on Lakes Erie and Ontario and at major urban centers, such as Chicago. Air monitoring data do not reflect reductions in B(a)P emissions that have been reported in emissions inventories. The absence of a corresponding decrease in the environment suggests that there are sources of B(a)P contributing to environmental levels that are unaccounted for or are underestimated in current inventories. To propose new reduction targets, much effort would be required to develop current and baseline inventories that provide accurate estimates of all potential sources of B(a)P. Thus, it does not seem practical to establish new challenge goals at this time. The final management outcome for B(a)P is continued active Level 1 status with reassessment in 2008 by the GLBTS. The GLBTS B(a)P Workgroup will:

1) Continue to pursue reduction activities, especially for the following source sectors:
   A) Residential Wood Combustion: "Burn-it-Smart," wood stove change-out programs, firelog testing, and begin to address wood boilers;
   B) Scrap Tires: Ontario Stewardship program, US Best Practices Guidebook, additional training and pile mapping.

2) Improve B(a)P inventories. The primary task is to identify missing sources, probably by source apportionment, and to identify source categories that have achieved virtual elimination.

3) Form an emission inventory subgroup for the above task (because inventories are an issue for more than one Level 1 substance, this may be one subgroup for all GLBTS substances).

4) Expand the workgroup scope to include PAHs and seek reduction opportunities.

5) Establish sector subgroups for any major sector that remains a significant contributor.

TABLE OF CONTENTS

ABBREVIATIONS

ASTM	ASTM International, originally known as the American Society for Testing and Materials
B(a)P	Benzo(a)pyrene
CCME	Canadian Council of Ministers of the Environment
COA	Canada-Ontario Agreement
EC	Environment Canada
HCB	Hexachlorobenzene
FDA	Food and Drug Administration
GLBTS	Great Lakes Binational Toxics Strategy
IADN	Integrated Atmospheric Deposition Network
IL EPA	Illinois Environmental Protection Agency
MOE	Ministry of the Environment (Ontario)
NAPS	National Air Pollution Surveillance Network
NHANES	National Health and Nutrition Examination Survey
NLFA	National Listing of Fish Advisories
OCS	Octachlorostyrene
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PM	Particulate Matter
US EPA	United States Environmental Protection Agency
USWAG	Utility Solid Waste Activities Group

DRAFT MANAGEMENT ASSESSMENT FOR BENZO(A)PYRENE

1.0 INTRODUCTION

The Great Lakes Binational Toxics Strategy (GLBTS) identifies specific reduction challenges or goals for each Level 1 substance for the U.S. and Canada. The time frame for achieving the Strategy's challenge goals expires in 2006. As 2006 approaches, an analysis of progress and determination of next steps is needed to respond to the mandate set forth in the Strategy. The *General Framework to Assess Management of GLBTS Level 1 Substances* was developed to provide a tool to assist the Parties (Environment Canada and US EPA) and stakeholders in conducting a transparent process to determine the appropriate management outcomes for the Level 1 substances: mercury, polychlorinated biphenyls (PCBs), dioxins and furans, hexachlorobenzene (HCB), benzo(a)pyrene (B(a)P), octachlorostyrene (OCS), alkyl-lead, and five cancelled pesticides: chlordane, aldrin/dieldrin, DDT, mirex, and toxaphene. The framework presents a logical flow diagram for evaluating progress and the need for further action by the GLBTS on the Level 1 substances. Further details on the background and objectives of the framework are provided in Appendix A.

This report discusses the analysis of benzo(a)pyrene (B(a)P) using the *General Framework to Assess Management of GLBTS Level 1 Substances.* While the framework's flow diagram guides the discussion, the primary intent of the analysis is to present an overall evaluation of the status of the substance with respect to:

- Progress toward the GLBTS challenge goals;
- Levels in the Great Lakes environment; and
- Future management of the substance within the GLBTS.

B(a)P (CAS registry number 50-32-8) is a member of a class of compounds known as polycyclic aromatic hydrocarbons (PAHs). PAHs generally occur as complex mixtures and not as single compounds. Thus, B(a)P emissions are often not reported alone but with a class of PAHs.

B(a)P is not manufactured or used commercially. It is primarily a by-product of incomplete combustion, but also occurs naturally in fossil fuels. B(a)P is formed when fuels, carbon-based waste, animal, or plant materials burn. Because of its lower vapor pressure, it is found largely in the particulate matter phase (e.g., soot), rather than in the vapor phase, in combustion emissions. B(a)P is also found in coal tar pitch and creosote, both of which are used as chemical wood preservatives. B(a)P release to the environment is quite widespread since it is a ubiquitous product of incomplete combustion.

B(a)P is considered a probable human carcinogen and has been shown to be carcinogenic in multiple animal studies in many species for various routes of exposure. Lung cancer has been shown to be induced in humans by various mixtures of PAHs known to contain B(a)P, including cigarette smoke, roofing tar, and coke oven emissions. This does not provide conclusive evidence, however, that B(a)P is the cause for cancer (US EPA, 2005a).

2.0 CHALLENGE GOAL STATUS

Have the challenge goals for the substance been met?

The GLBTS challenge goals for the U.S. and Canada, as stated in the 1997 Great Lakes Binational Toxics Strategy agreement, are:

Canadian Challenge: Seek by 2000, a 90 percent reduction in releases of B(a)P from sources resulting from human activity in the Great Lakes Basin, consistent with the 1994 Canada-Ontario Agreement.

U.S. Challenge: Seek by 2006, reductions in releases, that are within, or have the potential to enter the Great Lakes Basin, of B(a)P from sources resulting from human activity.

Both Canada and the U.S. have achieved reductions of B(a)P from sources resulting from human activity. While this satisfies the U.S. commitment, Canada continues to pursue the goal of a 90 percent reduction in B(a)P releases. A description of the progress made by each country is provided below.

Ontario

In Ontario, releases of B(a)P have been reduced by approximately 45 percent, relative to a 1988 baseline. Figure 1[1] illustrates B(a)P releases in Ontario, by sector, for 1988 and 2003. The majority of the reductions achieved by Ontario are the result of the following actions:

- Iron & Steel
  - Environment Canada adopted Environmental Codes of Practice for Integrated and Non Integrated Steel Mills, and the Canadian Steel Producers Association developed Environmental Best Practice Manuals for PAHs
  - Dofasco Inc. and Algoma Steel Inc. established Environmental Performance Agreements with Environment Canada and the Ontario Ministry of the Environment
  - Algoma Steel Inc. developed and implemented a proactive maintenance program and best management operating practices for the company's coke ovens[2]
  - In 1997, Stelco Hilton Works initiated a two-year Coke Oven Battery Refurbishment Project which included repair, refurbishment, and replacement of coke oven battery components. Stelco Lake Erie Works completed a similar battery refurbishment in 1997.[3]
- Residential Wood Combustion

[1] Based on "B(a)P/PAH Emissions Inventory for the Province of Ontario 1988, 1998 and 2000 Draft Report (No. 1), May 16, 2000" prepared for Environment Canada by Benazon Environmental Inc., updated by Environment Canada, Ontario Region, sector release estimates, and by NPRI facility release data.
[2] "The 1998 Progress Report on the Environment", Canadian Steel Producers Association, August 1999, http://www.canadiansteel.ca/newsroom/reports/environment_e.pdf.
[3] Ibid.

  - Promotion of EPA-certified wood stoves and good burning practices
- Petroleum Refining
  - Reduced releases from catalytic cracking units
- Wood Preservation
  - Implementation of a Technical Recommendations Document for the Design and Operation of Wood Preservation Facilities at wood treating facilities using creosote

Further incremental reductions in B(a)P emissions are anticipated, but it is unlikely that Canada's 90 percent reduction goal will be met by 2006. Total B(a)P releases in Ontario are estimated at 29,000 lbs (13,200 kg) per year.

A few barriers hinder the progress of achieving further B(a)P emission reductions in Ontario. Eighty percent of releases are primarily from non-point sources, where it can to difficult to obtain reductions: residential wood combustion, motor vehicle emissions, prescribed burning, and household waste burning. Iron and steel cokemaking still remains the largest B(a)P point source in spite of major reduction efforts—emissions were reduced by 73 percent in 2002 relative to a 1988 base year from 22,880 lbs to 6,098 lbs (from 10,400 kg to 2,772 kg). This sector faces significant challenges to remain cost competitive as it continues its efforts to reduce emissions. Although forest fires (wildfires) have not been included in Ontario's inventory of anthropogenic B(a)P sources, forest fires are a significant source in the basin and an area where GLBTS reduction opportunities are minimal. The focus of GLBTS actions is on sources resulting from human activity, and does not include forest fires.

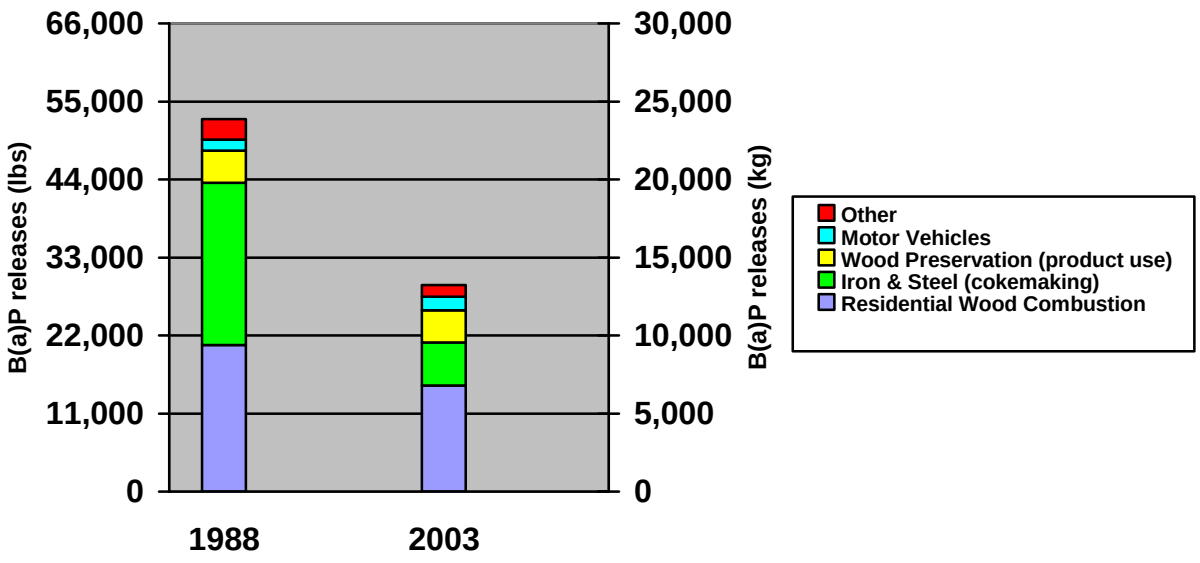


Figure 1. Estimated B(a)P Releases in Ontario by Sector, 1988 and 2003. Source: Environment Canada (Environmental Protection Branch - Ontario Region, Toxics Prevention Division) Inventory as of October 13, 2004.

United States

Figure 2[4] presents annual B(a)P release estimates and reduction progress within the U.S. Great Lakes Basin from 1996 to 2001. Emissions of B(a)P in the Great Lakes Basin have been reduced by approximately 77 percent during that time. Since the 2001 inventory was prepared, petroleum refinery emissions have been essentially eliminated, and emissions from primary aluminum manufacture and coke ovens have been substantially reduced. Residential wood combustion emissions remain the largest source of B(a)P emissions in the Great Lakes. Current estimated B(a)P emissions in the U.S. Great Lakes Basin are 43,700 lbs (19,900 kg) per year.[5]

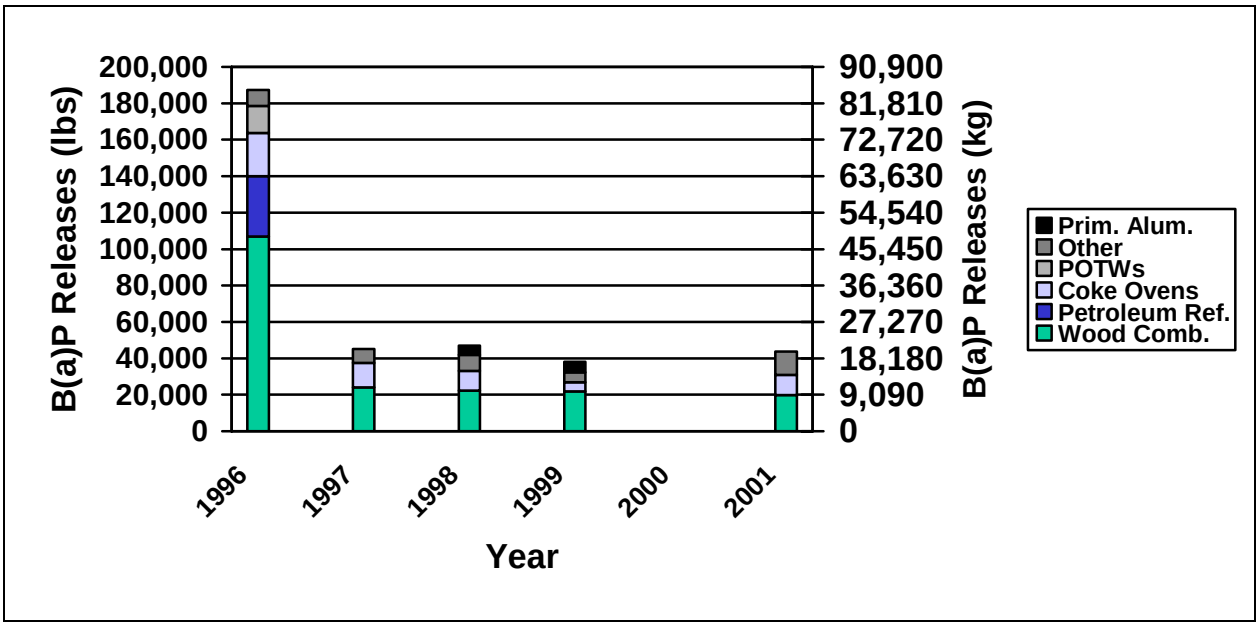


Figure 2. B(a)P Releases from the U.S. Great Lakes States, 1996-2001.[4]

3.0 ENVIRONMENTAL ANALYSIS

The *General Framework to Assess Management of GLBTS Level 1 Substances* calls for an analysis to consider Canadian and U.S. environmental monitoring data and established human health or ecological criteria as the primary basis for an objective evaluation of whether B(a)P imposes a negative impact on the Great Lakes Basin. In preparing this report, efforts were made to identify basin-specific measures in air, water, sediment, fish, wildlife, food, and human biological samples.

[4] Based on the Great Lakes Regional Air Toxic Inventory for 1996 through 2001, with Ontario emissions removed and petroleum refining emissions reduced to approximately 5 lbs beginning in 1997, per revised estimates provided by the American Petroleum Institute (API, 2001).
[5] Like Ontario's B(a)P emission inventory, forest fires are not included in these estimates.

3.1 ENVIRONMENTAL AND HUMAN HEALTH DATA

Table 1 presents environmental and human health data to assess the likely impact of the substance on the Great Lakes basin. The table and ensuing discussion show that, in general, **there are sufficient data on the environmental presence of B(a)P in multiple media** to assess the impact of B(a)P in the Basin.

Table 1. Environmental and Human Health Data.

DATA	RISK-BASED CRITERIA	EXCEEDANCES	TRENDS
Fish Tissue			
National Listing of Fish Advisories	US EPA cancer guideline:[1] 4 µg/kg (wet wt, for edible portion of fish)	5 advisories in rivers in Michigan and Ohio	N/A
U.S. National Fish Tissue Study[2]	See above	None: B(a)P not detected in first- & second-year samples	No trend data available
Sediment			
EC Sediment Contaminant Monitoring Programs[3]	PSQ LEL: 0.370 (µg/g) PSQ SEL: 1,440 (µg/g organic carbon) CSQ PEL in freshwater sediments: 782 (µg/kg dw) CCME in suspended sediment:[4] 31.9 ng/g		
- Lake Erie bottom sediment			Decline of 35%, 1997-2002
- Fort Erie suspended sediment	CCME 31.9 ng/g	Yes, from 1987 to 2000	Increase of 78%, 1989-2000 Trend stable since 1995
- Niagara-on-the-Lake suspended sediment	CCME 31.9 ng/g	Yes, from 1987 to 2000	Increase of 89%, 1989-2000
- Wolfe Island suspended sediment	CCME 31.9 ng/g	Yes, from 1992 to 2000	Decline of 72%, 1992-2000
Tributary Sediments (Lower Lakes 2001-2003)	CCME 31.9 ng/g	Criteria exceeded	Insufficient data to determine trends

DATA	RISK-BASED CRITERIA	EXCEEDANCES	TRENDS
12-Mile Creek/Old Welland Canal Sites (2003)	PSQ LEL: 0.370 (µg/g)	PSQ LEL exceeded at Totem, Carter Creek, and Eastchester	No trend data available
Open Water			
EC Sediment Contaminant Monitoring Programs[3]	US EPA guideline for water: 3.8 ng/L [5]		
- Niagara-on-the-Lake whole water[6]	See above	None	No apparent trend, 1986-2001
- Fort Erie dissolved phase	See above	None	Decline of 76%, 1991-2000
- Niagara-on-the-Lake dissolved phase	See above	None	Decline of 78%, 1987-2000 Trend stable since 1995
- Wolfe Island dissolved phase	See above	Insufficient quantifiable data to determine exceedance	Insufficient quantifiable data to determine a trend. DL = 0.01 ng/L
- St Clair – Detroit River Corridor	See above	Exceeded at Trenton Channel	Insufficient data to determine trends
EC Great Lakes Water Quality Surveillance Program[7]	See above	None	No apparent trend in available data, 1988-2002
Soil			
Concentrations of PAHs and Inorganic Constituents in Ambient Surface Soils, Chicago, Illinois: 2001-02[8]	IL EPA Tier I remedial objectives for ingestion of residential soil: 0.09 mg/kg; of industrial/commercial soil: 0.8 mg/kg; by construction worker: 17 mg/kg	89% of samples exceeded residential std; 54% exceeded industrial/commercial std; 4% exceeded construction worker std	No trend data available
Biota			
Ontario Ministry of the Environment Mussel Biomonitoring Program[9]	US EPA guideline for aquatic life: 18 ng/L [5]	None	No trend data available
Ambient Air			
Canadian National Air Pollution Surveillance (NAPS) Network	State/Provincial criteria[10]	None	Little change, 1997-2003
Integrated Atmospheric Deposition Network (IADN)	See above	None	No apparent trend, 1992-2002
Human Exposure			
Health Canada Exposure Assessment (1998)[11]	No tolerable daily intake guideline	N/A	No trend data available

[1] US EPA, 2000.
[2] US EPA, 2004b.
[3] Programs include the St. Clair-Detroit River Corridor Upstream/Downstream Water Quality Monitoring, Niagara River Upstream/Downstream Monitoring Program and St. Lawrence River Monitoring Program (US EPA, 2004a; Waltho, 2005).
[4] CCME, 1999.
[5] National recommended water quality criteria for protection of human health (US EPA, 2002).
[6] Contribution of sediment and water combined.
[7] Whole water (1988-1990) or dissolved phase data (1994-2002) for Lakes Superior, Huron, Erie, and Ontario and Georgian Bay (Waltho, 2005).
[8] Kay et al., 2003.
[9] Richman, 2005.

[10] The states of Indiana, Michigan, New York, and Pennsylvania have set average annual acceptable ambient air concentrations for B(a)P of 0.6 ng/m³, 0.3 ng/m³, 0.0 ng/m³, and 0.7 ng/m³, respectively. Ontario has established a provincial air quality guideline for B(a)P of 0.3 ng/m³.
[11] Health Canada, 1998.

Abbreviations used in the table:
CCME – Canadian Council of Ministers of the Environment
CSQ – Canadian Sediment Quality Guidelines
DL – detection limit
Dw – dry weight
IL EPA – Illinois Environmental Protection Agency
ISQG – Interim Sediment Quality Guideline
LEL – Lowest Effect Level
N/A – Not Applicable
PEL – Probable Effect Level
PSQ – Provincial Sediment Quality Guidelines
SEL – Severe Effect Level
WHO – World Health Organization
Wt – Weight

National Listing of Fish Advisories

The National Listing of Fish Advisories (NLFA) database, maintained by US EPA, includes all available information describing state-, tribal-, and federally-issued fish consumption advisories in the U.S. for the 50 States, the District of Columbia, and four U.S. territories, and in Canada for the 12 provinces and territories. The database contains information provided to US EPA by the states, tribes, territories, and Canada. The 2003 NLFA contains five active fish advisories for PAHs in rivers in Ohio and Michigan, and no fish consumption advisories for PAHs in the Great Lakes (US EPA, 2005b).

U.S. National Fish Tissue Study

The U.S. National Study of Chemical Residues in Lake Fish Tissue (or the National Fish Tissue Study) is a four-year national screening-level freshwater fish contamination study. The National Fish Tissue Study measures B(a)P in predator and bottom-dwelling fish tissue from lakes and reservoirs of the continental U.S. (excluding the Great Lakes). Analysis of the data for all four years of the study is not complete, but US EPA is releasing interim raw data for each year as it becomes available. A final report is expected to be completed in 2006.

Data are currently available for the first two years of the study. The first-year results consist of quality-assured raw data from analysis of fish samples collected from 143 lakes and reservoirs in the lower 48 states during fall 1999 through 2000 (US EPA, 2005c). B(a)P was not detected in first-year samples, which included locations at 45 sites in the Great Lakes states of New York, Pennsylvania, Ohio, Michigan, Illinois, and Minnesota (31 percent of first year sites). The second-year results consist of quality-assured raw data from analysis of fish samples collected from 117 lakes and reservoirs in the lower 48 states during 2001. B(a)P was also not detected at sites sampled in the second year of the study. The minimum level of quantitation for B(a)P in the first- and second-year analyses was generally 111 μg/kg (US EPA, 2004b).

The data available for the first two years of the National Fish Tissue Study include over half of the approximately 500 lakes and reservoirs being sampled in the study. The Great Lakes were excluded from the lakes selected for the study, but lakes and reservoirs in the Great Lakes Basin were included. Levels of B(a)P below the limit of detection in the first two years of the study indicate that B(a)P levels in fish are not likely to represent a significant concern.

Environment Canada Water and Sediment Contaminant Monitoring Programs

Environment Canada began surface water monitoring in the open lakes and interconnecting channels in the late 1970s through the mid 1980s. Water and sediment contaminant monitoring programs are ongoing in the open waters and interconnecting channels of the Great Lakes. These programs include the *St. Clair – Detroit River Corridor Water Quality Monitoring Program*, *Niagara River Upstream/Downstream Monitoring Program* and *St. Lawrence River Monitoring Program*, the *Great Lakes Water Quality Surveillance Program*, screening level surveys of sediment quality in Canadian tributaries to Lakes Erie and Ontario, and bottom sediment contaminant surveys conducted in the Great Lakes. Descriptions of the *Niagara River Upstream/Downstream Monitoring Program* and the *St. Lawrence River Monitoring Program* are provided in Appendix B. Due to the ongoing and comprehensive nature of these programs, spatial and temporal trends reflecting the impact of B(a)P on water quality can be assessed over the Great Lakes Basin. However, data with which to assess spatial and temporal trends that reflect the impact of B(a)P on sediment quality are limited.

The interconnecting channels programs in the St. Clair, Detroit, and Niagara Rivers provide information suggestive of local sources. The *St. Clair – Detroit River Corridor Water Quality Monitoring Program* includes one mid-channel upstream site and two downstream sites (one on the Canadian side and one on the U.S. side) in each river. This is a relatively new program and, as such, provides insufficient data to assess trends. A discussion of the objectives and sampling strategy for the whole-water monitoring program initiated by Environment Canada in 2001 for the St. Clair and Detroit Rivers is provided in Appendix B.

Table 2 presents mean whole-water B(a)P concentrations collected from thirteen surveys conducted in the St. Clair-Detroit River Corridor in 2001 and 2002. Whole-water levels of B(a)P in the Trenton Channel of the Detroit River (on U.S. side) are much higher than levels upstream and at the Canadian downstream site, suggesting the presence of local sources. B(a)P concentrations in the Trenton Channel exceed the US EPA guideline of 3.8 ng/L for B(a)P for consumption of water. (Section 3.2 discusses criteria and exceedances.) B(a)P concentrations at the other sites along the corridor are well below the US EPA guideline.

Table 2. Mean Whole-water Concentrations of B(a)P (ng/L) based on Thirteen Surveys Conducted in St. Clair-Detroit River Corridor in 2001 and 2002

St Clair River			Detroit River		
Upstream	Downstream		Upstream	Downstream	
Inlet (Nav. Channel)	Roberts Landing	Port Lambton	Fleming Channel	Trenton Channel	Amherst. Channel
0.02	0.18	0.13	0.31	6.44	0.72

Reference: Waltho, 2005.

Dissolved phase and suspended sediment data were collected at Fort Erie, the upstream station, and Niagara-on-the-Lake, the downstream station on the Niagara River, through the *Niagara River Upstream/Downstream Monitoring Program.* At Niagara-on-the-Lake, B(a)P concentrations in suspended sediment have increased 89 percent from 1989 to 2000, exceeding the CCME guideline of 31.9 ng/g for B(a)P concentrations in suspended sediment. At this same

location, dissolved phase B(a)P concentrations have declined 78 percent from 1987 to 2000 (Waltho, 2005). When the measurements for water and sediment are combined into a whole water analysis, it appears that the increase in suspended sediment and the decrease in dissolved phase B(a)P concentrations tend to offset each other. Figure 3 shows that B(a)P levels in whole water at Niagara-on-the-Lake have remained fairly consistent from 1986 to 2001 (US EPA, 2004a).

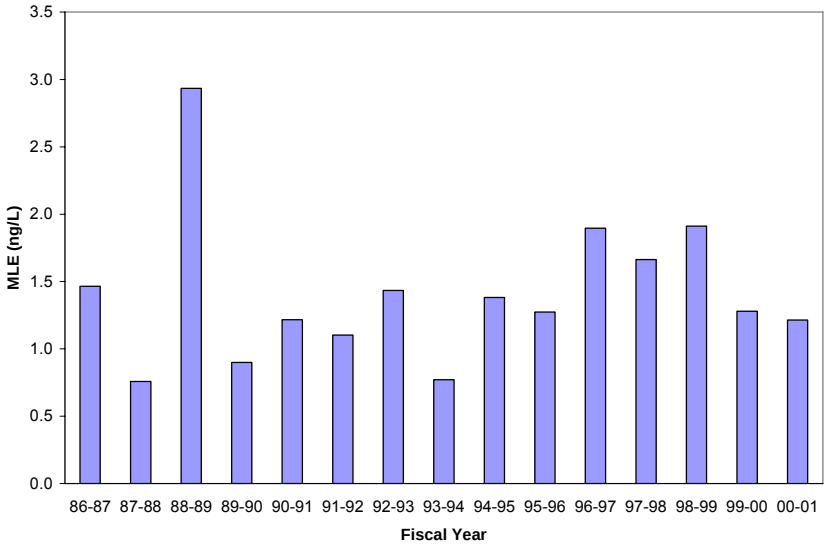


Figure 3. Whole Water B(a)P (ng/L) at Niagara-on-the-Lake, 1986-2001. Source: Environment Canada.

The same pattern appears to be present at Fort Erie. B(a)P concentrations in suspended sediment increased 78 percent from 1989 to 2000, exceeding the CCME guideline of 31.9 ng/g, with stable concentrations since 1995, while dissolved phase B(a)P levels declined 76 percent from 1991 to 2000 (trend analysis and percent change were calculated using the LifeReg model developed by A.H. El-Shaarawi (El-Shaarawi and Ventressca, 1998); data analysis provided by Waltho, 2005).

Dissolved phase and suspended sediment data were collected at Wolfe Island through the *St. Lawrence River Monitoring Program*. B(a)P concentrations in suspended sediment at Wolfe Island declined 72 percent from 1992 to 2000. Insufficient quantifiable data were available to determine a trend in dissolved phase B(a)P levels at Wolfe Island.

The *Great Lakes Water Quality Surveillance Program* conducts spring and/or summer cruises on Lake Superior, Lake Huron/Georgian Bay, Lake Erie, and Lake Ontario on a rotating schedule according to a standardized sampling regime coordinating with other programs. The lakes are sampled for a wide array of organic contaminants in addition to nutrients, major ions, physical and biological parameters. Table 3 presents data for B(a)P collected from 1988 to 2002 on Lakes Superior, Huron, Erie, and Ontario and Georgian Bay. There is no apparent trend in the available data collected on Lakes Superior, Huron, Erie, and Ontario and Georgian Bay from 1988 to 2002 (Waltho, 2005).

Table 3. Great Lakes Water Quality Surveillance Program Data for B(a)P (ng/L), 1988-2002.

LAKE	LAKEWIDE MEANS*										
	1988	1990	1994	1995	1996	1997	1998	1999	2000	2001	2002
Superior					<0.05	0.048				<0.05	
Huron	<0.46							<0.05	<0.05		<0.05
Erie			<0.24	0.11			0.08		0.13		0.053
Ontario	<0.46	<0.46					0.11	0.06		0.019	
Georgian Bay	<0.46							<0.05	<0.05		<0.05

* Data for 1988 and 1990 are for whole water; data after 1990 are for the dissolved fraction. All data in ng/L.
Reference: Waltho, 2005.

Over the period 2001-2003, Environment Canada conducted screening level surveys of sediment quality in 101 Canadian tributaries to Lake Erie, including those into the St. Clair and Detroit River corridor and 211 Canadian tributaries to Lake Ontario, including the Niagara River and the St. Lawrence River. The sampling and analytical methodology for the surveys is described in Appendix B. The purpose of the screening level surveys was to assess sediment quality in each tributary prior to discharge into their respective receiving waters. The study was designed to maximize the probability of detecting PCBs, organochlorine pesticides, PAHs, and metals in these tributaries, rather than quantify contaminant loads. Results were compared to existing federal and provincial sediment quality guidelines (CCME, 1999; Persaud et al., 1993) to determine compliance. The data provide information on the sediment quality of Canadian tributaries in the lower Great Lakes. Results for B(a)P indicate exceedances of Canadian federal sediment quality guidelines (Waltho, 2005). The data collected for 2001-2003 are insufficient to generate reliable trend information.

Bottom sediment contaminant surveys conducted in the Great Lakes from 1997 to 2002 provide a good illustration of the spatial distribution of contaminants, and in concert with sediment cores, also provide a temporal perspective. Comparisons of surficial sediment concentrations with sub-surface maximum concentrations suggest that B(a)P concentrations have decreased by 35 percent in Lake Erie. Data were not available to determine B(a)P trends in the other Great Lakes (US EPA, 2004a).

Sediment contamination also provides an indication of impacts of local historical sources, and through comparison to surveys conducted in the late 1960s and early 1970s, a regional perspective of the ambient environmental response to management initiatives. Open-lake bottom sediment contaminant information has been collected for all the Great Lakes. Historical sources and their impacts are evident through comparison to earlier work and by analysis of archived samples. The available open-lake sediment data for B(a)P in the lower Great Lakes illustrate a common theme. In general, the western basin of Lake Erie and the depositional basins of Lake Ontario exhibit the highest concentrations of B(a)P. These regional patterns reflect sediment characteristics, depositional processes, bathymetry, and location of historical sources (US EPA, 2004a).

Twelve Mile Creek/Old Welland Canal

The Ontario Ministry of the Environment (OMOE) and Environment Canada are jointly applying a "trackdown" strategy with the overall goal of determining whether observed concentrations of priority pollutants in major tributaries to the Great Lakes can be attributed to locally controllable sources, or whether they reflect recycled contaminants from diffuse historical sources. A pilot study, called *Project Trackdown*, responds to the Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem.

Three tributaries of Lake Ontario were selected for the pilot project: Twelve Mile Creek, Etobicoke Creek, and the Cataraqui River. Each tributary has previously exhibited some indication of elevated contaminant levels in water, sediment, or biological tissue relative to background conditions. Upstream/downstream differences in contaminant concentrations in each of these tributaries are in the process of being quantified using water, sediment, and juvenile fish data, and/or by quantifying differences in mussel (*Elliptio complanata*) tissue concentrations from selected points throughout each watershed.

Twelve Mile Creek was the first of the pilot projects to be studied. The creek has a relatively small watershed and more than 95 percent of the water entering the creek is Lake Erie water diverted through the Welland Canal. Table 4 presents levels of B(a)P in sediment collected at Twelve Mile Creek Old Welland Canal sites in 2003.

The data in Table 4 indicate that sediment quality is marginally polluted at some Twelve Mile Creek Old Welland Canal tributary stations, as indicated by exceedances of the Ontario PSQ LEL. Section 3.2 discusses criteria for B(a)P and exceedances observed in the Great Lakes environment.

Table 4. Environment Canada B(a)P Sediment Data Collected at 12-Mile Creek Old Welland Canal Sites, 2003.

TRIBUTARY STATIONS	LOCATION	SAMPLING DATE	B(A)P (µg/g)	CRITERIA EXCEEDANCES
Totem	Old Welland Canal	25-Aug-03	0.413	PSQ LEL
		25-Aug-03	0.743	PSQ LEL
Carter Creek	Old Welland Canal	25-Aug-03	0.470	PSQ LEL
Dicks Creek	Old Welland Canal	25-Aug-03	<0.025	
Richardsons Creek Mouth (Leading into Martindale Pond)		28-Aug-03	0.297	
First Street Louth	12 Mile Creek upstream Reference (like MOE's station 202)	28-Aug-03	<0.025	
OWC Cliff	Old Welland Canal at Clifford Creek	20-Oct-03	<0.025	
Glengary	OWC at Glengary Park	20-Oct-03	0.333	
		20-Oct-03	0.340	
Eastchester	Carter Creek, upstream of mouth	20-Oct-03	0.474	PSQ LEL

Source: Ontario Ministry of the Environment (Boyd, 2005)
PSQ LEL = 0.370 (µg/g) dry weight

Concentrations of PAHs and Inorganic Constituents in Ambient Surface Soils, Chicago, Illinois: 2001-02

The U.S. Department of the Interior and the U.S. Geological Survey, in cooperation with the Chicago Department of the Environment, measured concentrations of PAHs in ambient surface soils in Chicago, Illinois, between June 2001 and January 2002 (Kay et al., 2003). Fifty-seven samples were collected from randomly selected sites within the city boundary. B(a)P was detected in all samples. The average concentration of B(a)P (natural-log transformed) in ambient surface soils in Chicago was 6.8 µg/kg. Concentrations were compared to guidelines set by the Illinois Environmental Protection Agency (EPA) for remediation of contaminated soils. Section 3.2 discusses these criteria for B(a)P and exceedances observed in Chicago soils.

Niagara River Mussel Biomonitoring Program

The Ontario Ministry of Environment has conducted the Niagara River Mussel Biomonitoring program since 1980. Data generated by the program provide information on contaminants in the Niagara River between Fort Erie and Niagara-on-the-Lake. The mussel biomonitoring program has provided information on suspected contaminant sources and source areas in the river and is part of an overall program to assess long-term trends in contaminant loadings from selected U.S. and Canadian sources along the Niagara River.

The Niagara River Mussel Biomonitoring program uses mussels as biomonitors. Biomonitors are an effective means of detecting bioaccumulative contaminants in the water when ambient concentrations are too low to be measured directly using conventional water sampling and analytical methods. The principle behind the mussel biomonitoring program is to take organisms from an uncontaminated site and place them in an environment that is known or suspected of being contaminated with persistent bioaccumulative substances. The biomonitors are left for a specified time to accumulate contaminants and are then analyzed to determine the contaminant concentrations in their tissue. By strategically placing the organisms upstream and downstream from a source, the presence or absence of contaminants in the water body can be determined. The detection of contaminants in the mussels indicates that the contaminants are bioavailable in the aquatic environment. The absence of a contaminant in mussel tissue is less definitive. It may suggest that the contaminant is not present or that it is not bioavailable in the surrounding environment. However, because of the site-specific nature of the biomonitor, it may also mean that the mussels were not placed near enough to the source to adequately detect the presence of contaminants.

Results of the Niagara River Mussel Biomonitoring program have shown that concentrations of B(a)P have typically been low or below the detection limit. PAHs were consistently detected in mussels in small tributaries to the Niagara River or at sites associated with storm sewers. Mussels were analyzed for PAHs during only a few survey years, and data are insufficient to determine temporal trends (Richman, 2005).

National Air Pollution Surveillance (NAPS) Network

Through the National Air Pollution Surveillance (NAPS) network, data are collected on ambient air levels for a variety of toxics at rural, suburban, urban, and industrial sites in Canada. This effort is carried out in cooperation with provincial environmental and municipal agencies. The program includes measurement of many organic compounds and components of fine particulate matter (PM), including metals and inorganic and organic ions, and persistent, toxic semi-volatile organic compounds. One of the purposes of the monitoring effort is to provide data on trends in air concentrations of toxics and thus measure the success of initiatives carried out under the Toxic Substances Management Policy (TSMP) and the Canada-Ontario Agreement (COA) respecting the Great Lakes Basin Ecosystem.

Figure 4 presents trends in ambient B(a)P concentrations at two urban sites in Ontario, Toronto and Windsor. Figure 5 presents trends in ambient B(a)P concentrations at three rural sites: Pt. Petre, 160 km (100 miles) east of Toronto; Egbert, 70 km (44 miles) north of Toronto; and Simcoe, 130 km (81 miles) southwest of Toronto. The box plots show median, 25th and 75th percentiles, and non-outlier minimum and maximum. Detection levels were 0.01-0.03 ng/m^3. The data show little change in B(a)P concentrations over time. B(a)P concentrations were an order of magnitude higher at urban sites than at most rural sites, indicating releases from local sources in urban areas (Curren and Dann, 2004). B(a)P was detected at 81 percent of Ontario sites from 1999 to 2003.

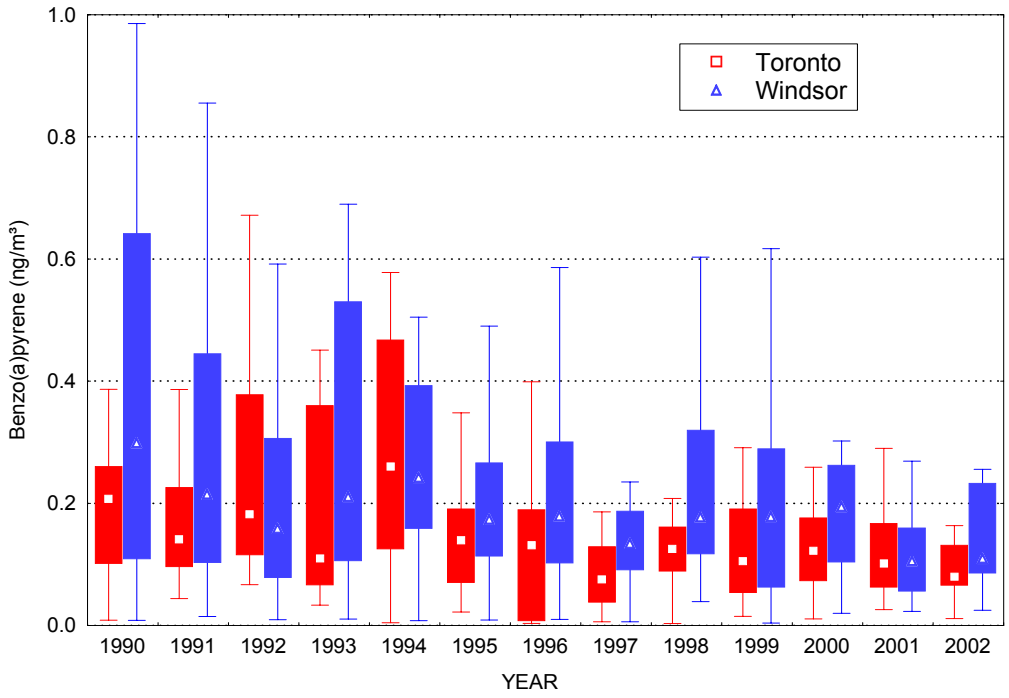


Figure 4. Trend in B(a)P Ambient Air Concentrations (ng/m³) at Urban Sites (1990-2002).[6]

[6] Source: Tom Dann, Environment Canada Analysis and Air Quality Division. The combined concentrations of B(a)P in the particulate and vapor phases are reported.

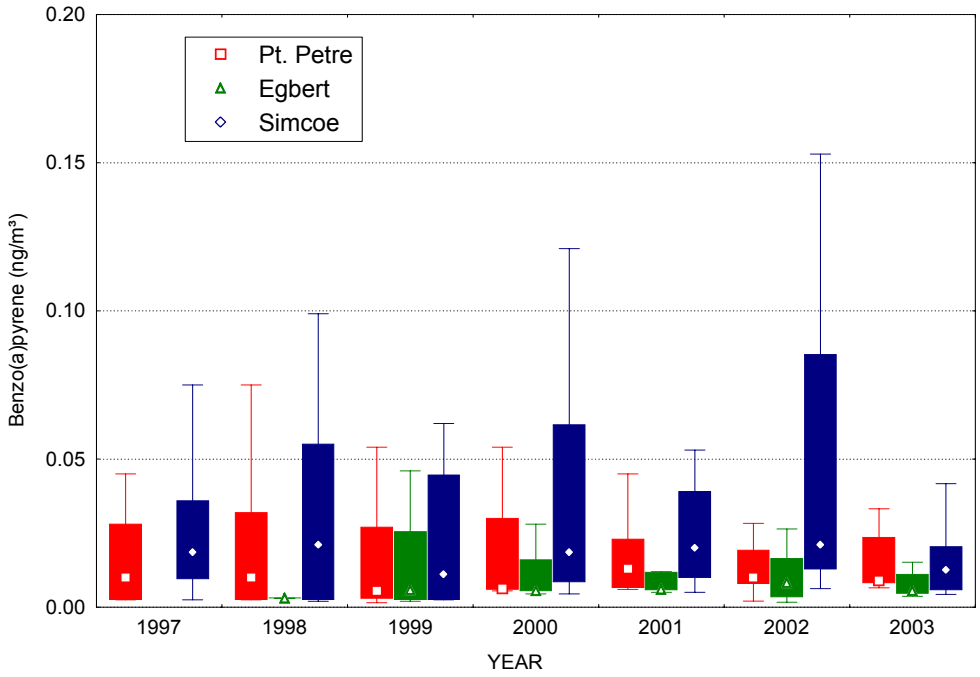


Figure 5. Trend in B(a)P Ambient Air Concentrations (ng/m³) at Rural Sites (1997-2003).[7]

Integrated Atmospheric Deposition Network (IADN)

The Integrated Atmospheric Deposition Network (IADN) is a joint United States/Canada atmospheric monitoring network that has been in operation since 1990. The IADN consists of five master stations, one near each of the Great Lakes, and several satellite stations. Three master stations are U.S. sites and two are Canadian sites. Concentrations of PCBs, organochlorine pesticides, polycyclic aromatic hydrocarbons (PAHs), and trace metals are measured in ambient air (gas phase), suspended particles, and precipitation at each station. These data are used to examine spatial and temporal trends of toxic contaminants in air and precipitation in the Great Lakes.

Figure 6[8] presents average annual particle-phase B(a)P concentrations measured at IADN master stations from 1992 to 2002. Concentrations of B(a)P at Great Lakes sites show no apparent trend from 1992 to 2002. Concentrations of B(a)P are relatively high on Lakes Erie and Ontario, sites near major population centers. Concentrations in Chicago (not shown) are about 10 to 100 times higher than concentrations at the IADN master stations.

[7] ibid

[8] Because B(a)P tends to absorb to particles, B(a)P levels in the particle phase are usually much higher than those in the vapor phase of ambient air.

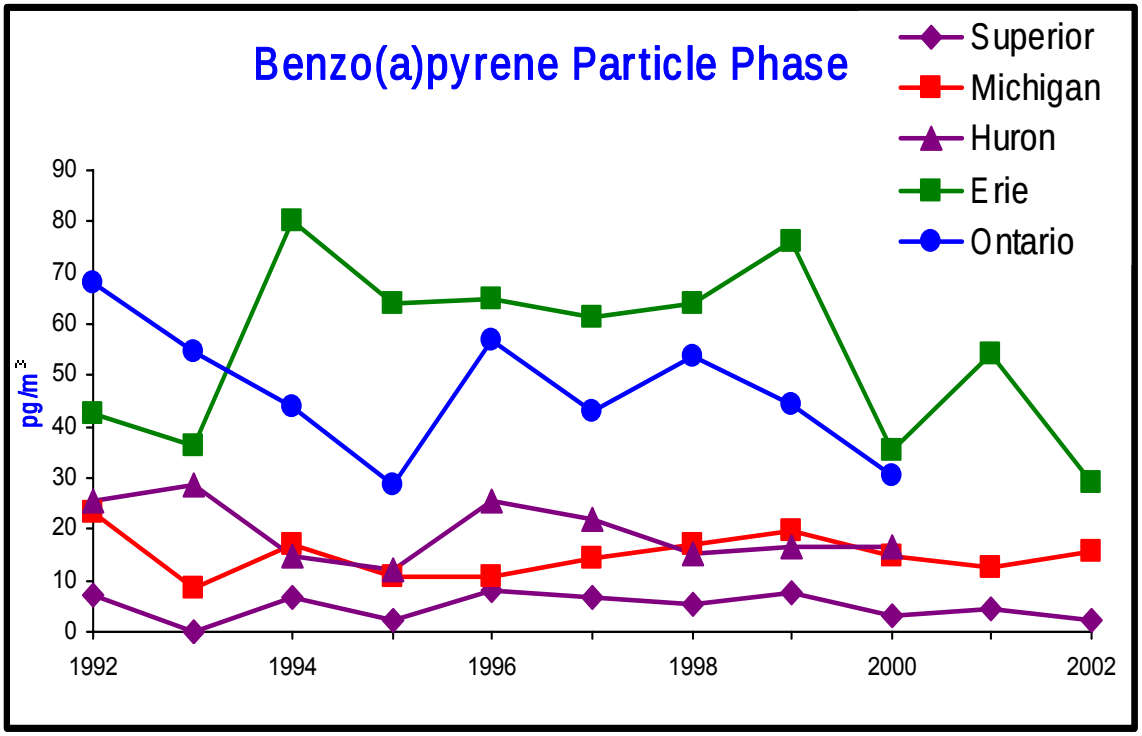


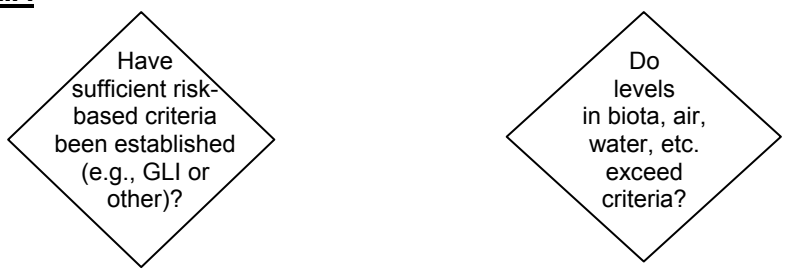
Figure 6. Annual Average Particle-Phase B(a)P Concentrations (pg/m^3).[9]

Human Exposure

In 1998, Health Canada estimated the average daily intake of B(a)P for Canadian Great Lakes Basin residents (Health Canada, 1998). This assessment considered exposures to the population through ingestion of food and water, incidental ingestion of soil and house dust, and inhalation of ambient and indoor air. The estimated daily intake of B(a)P, averaged over a 70-year lifetime, is 2.76 ng/kg of bodyweight (bw) per day and ranges from 1.2 ng/kg bw/day for breast-fed infants to 8.02 ng/kg bw/day for preschoolers aged 7 months to 4 years. No tolerable intake guideline for B(a)P has been established.

[9] IADN Steering Committee, unpublished data, 2004.

3.2 CRITERIA



Criteria with which to assess the impact of B(a)P on the Basin are available in nearly all media. Criteria have been developed for B(a)P levels in fish tissue, aquatic life, air, water, soil, and suspended sediment. There are no generally recognized criteria for B(a)P levels in human tissue. However, the need to develop human health criteria with which to identify exceedances is not a high-priority. Comparison of the data presented in Section 3.1 with available criteria indicate that **B(a)P levels in Great Lakes soil and sediment exceed criteria while B(a)P levels in fish tissue, air, and water are below available criteria**.

For contaminant concentrations in fish tissue, the US EPA has developed guidance documents to help state, local, regional, and tribal environmental health officials who are responsible for developing and managing fish consumption advisories. In these documents, US EPA issued risk-based monthly fish consumption limit tables for various chemicals. For B(a)P in the edible portion of fish, the carcinogenic health endpoint is 4 μg/kg (wet weight) (US EPA, 2000). There are currently (2003) no fish advisories for B(a)P limiting fish consumption in any of the Great Lakes.

The US EPA has issued national recommended water quality criteria for protection of human health, pursuant to Section 304(a) of the Clean Water Act (US EPA, 2002). For B(a)P, the US EPA guideline for consumption of water is 3.8 ng/L. The available data from the *St Clair – Detroit River Corridor Water Quality Monitoring Program* (Table 2), *Niagara River Upstream/Downstream Monitoring Program*, and the *Great Lakes Water Quality Surveillance Program* (Table 3) indicate that concentrations of B(a)P are below the US EPA criterion except at the Trenton Channel on the U.S. side of the Detroit River.

The Canadian Council of Ministers of the Environment (CCME) has established a guideline of 31.9 ng/g for B(a)P concentrations in suspended sediment. Environment Canada has reported the following exceedances of this CCME guideline (Waltho, 2005):

- Suspended sediments at Fort Erie and Niagara-on-the-Lake from 1987 to 2000.
- Suspended sediments at Wolfe Island from 1992 to 2000.
- Sediments in Canadian tributaries to Lakes Erie and Ontario (2001-2003).

In 1993, the Ontario Ministry of the Environment published *Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario*. These Provincial Sediment Quality (PSQ) guidelines establish three levels of effect: no effect level, lowest effect level (LEL), and severe effect level (SEL). At the no effect level, substances have no toxic effects on aquatic organisms and exhibit no biomagnification through the food chain. At the lowest effect level, substances have no effect on the majority of benthic organisms, and the sediment is considered marginally polluted. At the severe effect level, substances have a significant detrimental impact on benthic

organisms in the sediment. For B(a)P, no value has been determined for the no effect level, the lowest effect level is 0.370 μg/g (ppm) dry weight, and the severe effect level is 1,440 μg/g organic carbon (MOE, 1993).

Exceedances of the PSQ LEL guideline were observed in sediment data collected in 2003 at three of the eight tributary stations to Twelve Mile Creek Old Welland Canal (at Totem, Carter Creek, and Eastchester). The data are presented in Table 4 and discussed in Section 3.1. As described above, these exceedances indicate that sediment quality at these sites is marginally polluted and has the potential to affect some benthic organisms.

The Illinois EPA requires remediation of soils containing concentrations of PAHs above those published in the Illinois EPA *Tiered Approach to Cleanup Objectives* guidance document. The Illinois cleanup objectives depend on the intended future land use of a site. The following Tier I remedial objectives were compared to B(a)P levels in ambient surface soils in Chicago collected in 2001-2002: for ingestion of residential soil, 0.09 mg/kg; for ingestion of industrial/ commercial soil, 0.8 mg/kg; for ingestion of soil by a construction worker, 17 mg/kg (Kay et al., 2003). Of 57 samples collected in the City of Chicago, 89 percent of samples (51) exceeded the residential soil standard for B(a)P; 54 percent of samples (31) exceeded the industrial/ commercial standard for B(a)P; and 4 percent of samples (2) exceeded the standard for ingestion of soil by construction workers.

While there are no federal guidelines for B(a)P levels in air, the states of Indiana, Michigan, New York, and Pennsylvania have set average annual acceptable ambient air concentrations for B(a)P of 0.6 ng/m³, 0.3 ng/m³, 0.0 ng/m³, and 0.7 ng/m³, respectively. Ontario has established a provincial air quality guideline for B(a)P (annual acceptable ambient air concentration of 0.3 ng/m³). With the exception of New York's zero tolerance standard (0.0 ng/m³), recent B(a)P concentrations measured at NAPS and IADN sites in the Great Lakes are below these state/provincial criteria.

3.3 TRENDS

The data presented in Section 3.1 illustrate two common themes. Temporally, the data indicate **no apparent trend in environmental levels of B(a)P** over the past decade. Spatially, concentrations of B(a)P tend to be **higher on Lakes Erie and Ontario** than on the other Great Lakes. Sediment data for B(a)P indicate a declining trend in Lake Erie sediment, but lakewide trend data are not available for the other Great Lakes. Trend data are not available for B(a)P levels in fish tissue,[10] biota, and human serum in the Great Lakes Basin.

[10] Due to an increase in the number of assessments of fish and wildlife tissues, and the increasing use of fish advisories, trends in the number of fish consumption advisories issued may not accurately reflect changes in levels of fish contamination.

Along the Niagara River, increasing B(a)P levels have been observed in suspended sediment but declining trends in the dissolved phase. Considering the contribution of sediment and water combined, a whole water analysis indicates no apparent trend in B(a)P levels at Niagara-on-the-Lake. Similarly, data collected at Fort Erie show a declining trend in the dissolved phase, an increasing trend in suspended sediment, and a stable trend since 1995.

Environmental data for B(a)P are presented in Section 3.1, and Table 1 identifies trends in the data. The following trends in the data were observed:

- B(a)P concentrations in Lake Erie bottom sediment have decreased by 35 percent from 1997 to 2002.
- B(a)P levels in whole water have remained fairly consistent at Niagara-on-the-Lake, the downstream station in the Niagara River, from 1986 to 2001 (Figure 3).
- There is no apparent trend in the available water quality data collected on Lakes Superior, Huron, Erie, and Ontario and Georgian Bay from 1988 to 2002 (Table 3).
- Little change was observed in B(a)P air concentrations at both urban and rural NAPS sites from 1997 to 2003 (Figures 4 and 5).
- No apparent decline in particle-phase B(a)P levels at IADN sites (Figure 6), with higher concentrations observed near major population centers, particularly Chicago.

3.4 ENVIRONMENTAL ASSESSMENT CONCLUSIONS

In general, basinwide environmental data indicate that there has been **little change in B(a)P concentrations in the Great Lakes over the past decade**. However, a recent declining trend has been reported in Lake Erie bottom sediment, the only lake with available lakewide sediment data. **B(a)P levels in Great Lakes soil and sediment exceed criteria while B(a)P levels in fish tissue, air, and water are below available criteria**. Higher concentrations of B(a)P are found on Lakes Erie and Ontario than on the other Great Lakes, at sites near major population centers.

4.0 GLBTS MANAGEMENT ASSESSMENT

The key question to consider in the GLBTS management assessment of a Level 1 substance is whether the GLBTS can effect further reductions. To answer this question, this section briefly summarizes sources of B(a)P, current regulations and programs, and reduction opportunities.

4.1 SOURCES

4.1.1 Inventory Sources

Figure 7 illustrates sources of B(a)P release in Ontario using 2003 estimates developed by Environment Canada. Table 5 presents estimated releases of anthropogenic sources of B(a)P in Ontario, by source sector. Note that forest fires (or wildfires) are a significant source of B(a)P that are not included in the Ontario inventory, because forest fires are not considered an anthropogenic source.

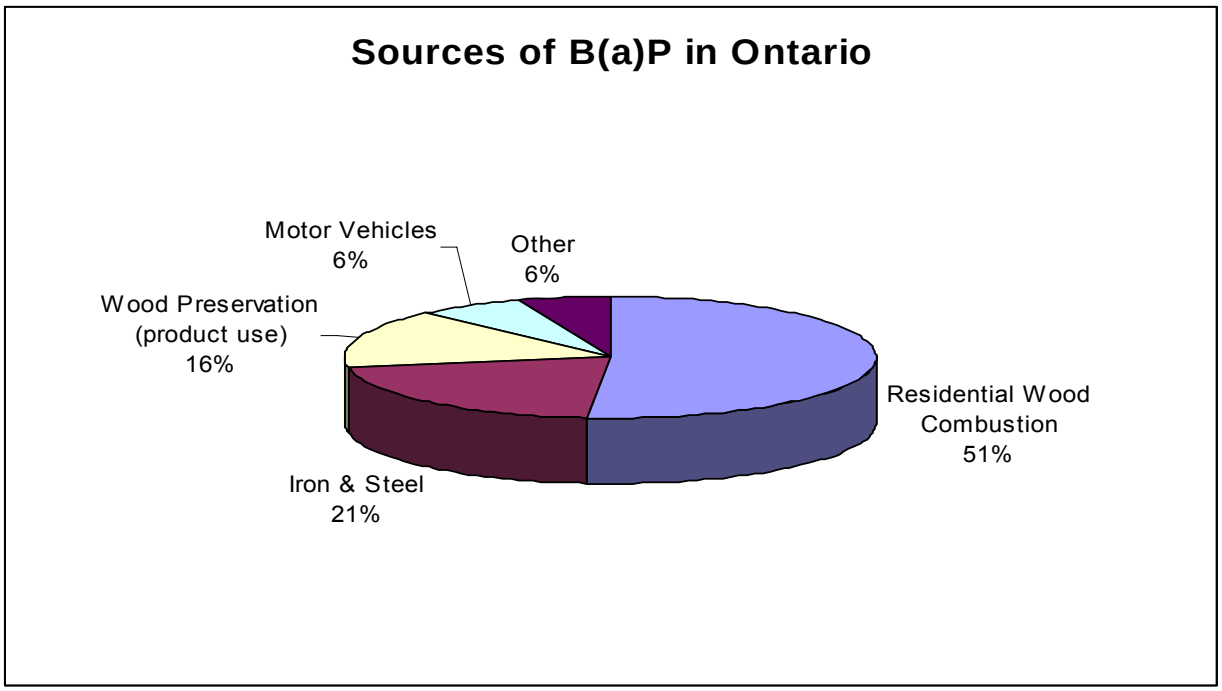


Figure 7. Anthropogenic Sources of B(a)P in Ontario, 2003 Estimates.[11]

Table 5. Inventory of Anthropogenic Sources of B(a)P in Ontario, and Estimated Releases.[11]

Inventory Source	Percent Release	Release Estimate (lbs/year)	Release Estimate (kg/year)
Ontario Sources (2003 estimates)			
Residential Wood Combustion	51%	14,938	6,790
Iron & Steel	21%	6,098	2,772
Wood Preservation (product use)	16%	4,532	2,060
Motor Vehicles	6%	1,892	860
Other	6%	1,650	750
TOTAL	**100%**	**29,110**	**13,232**

The Ontario inventory uses the most up-to-date release information available based on Canada's National Pollutant Release Inventory and other estimates, with a minor reliance on the Great Lakes Regional Air Toxic Emissions Inventory. The regional inventory does not include the major non-point sources, and the data are not as current.

Figure 8 illustrates sources of B(a)P release in the U.S. Great Lakes states using 2001 estimates from the Great Lakes Regional Air Toxic Emissions Inventory. Table 6 presents estimated releases of B(a)P in the U.S. Great Lakes states, by source sector.

[11] Environment Canada 2003 Release Update

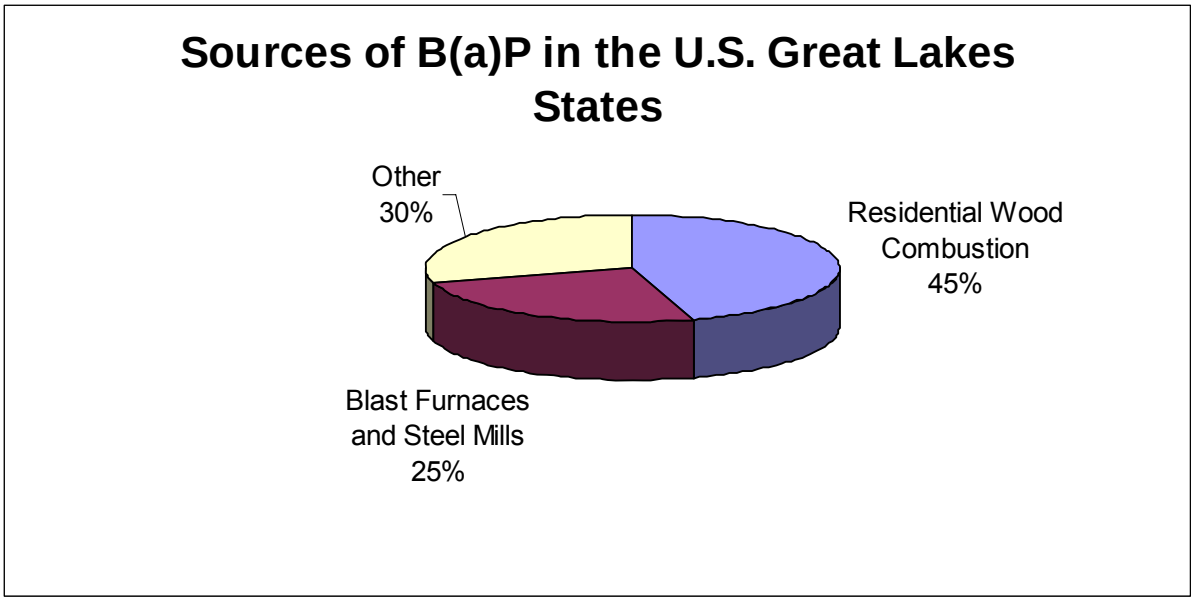


Figure 8. Anthropogenic Sources of B(a)P in the U.S. Great Lakes States.[12]

Table 6. Inventory of Anthropogenic Sources of B(a)P the U.S. Great Lakes States, and Estimated Releases.[12]

Inventory Source	Percent Release	Release Estimate (lbs/year)	Release Estimate (kg/year)
U.S. Great Lakes Sources (2001 estimates)			
Residential Wood Combustion	45%	19,762	8,983
Blast Furnaces and Steel Mills	25%	11,043	5,020
Other	30%	12,939	5,881
TOTAL	**100%**	**43,745**	**19,884**

Estimated B(a)P emissions in the U.S. Great Lakes states are 43,745 lbs (19,884 kg) per year. However, the B(a)P estimates include emissions from Illinois, Indiana, Michigan, Minnesota, Ohio, New York, and Wisconsin, but data for Pennsylvania are missing. The emission inventories for Ontario and the U.S. need to be reviewed for completeness, consistency, and comparability with each other. For example, some source sectors (e.g., motor vehicles, wood preservation) appear to be missing from the Great Lakes Regional Air Toxic Emissions Inventory (Figure 8 and Table 6). Based on Ontario's estimates, B(a)P emissions from motor vehicles and creosote-treated wood preservation in the U.S. could be significant sources that are absent from the Great Lakes inventory.

[12] Great Lakes Regional Toxic Air Emissions Inventory, 2001,with Ontario emissions removed and petroleum refining emissions reduced to 5 lbs, per revised estimates provided by the American Petroleum Institute (API, 2001).

4.1.2 Current Sources Not in Inventories

Table 7 presents estimated releases for a number of sources of B(a)P that are missing from the Ontario B(a)P inventory (Table 5) and the Great Lakes B(a)P inventory (Table 6). The sources listed in Table 7 are known or have the potential to be found in the Great Lakes.

Table 7. Potential Sources of B(a)P and Estimated Releases.

POTENTIAL SOURCE	BASIS FOR CONCERN ABOUT POSSIBLE RELEASES
Forest and Wildfires	Estimated B(a)P emissions in U.S.: 2 million lbs (909,100 kg)[1]
	Estimated B(a)P emissions in U.S. Great Lakes Basin: 4,697 lbs (2,135 kg)[2,3]
	Estimated B(a)P emissions in Ontario: 9,038 lbs (4,108 kg)[2,3]
Residential Burning of Household Waste	Estimated B(a)P emissions in U.S.: 41,660 lbs (18,936 kg)[1]
	Estimated B(a)P emissions in Ontario: 323 lbs (147 kg)[4]
Scrap Tire Fires	Estimated B(a)P emissions in U.S.: 32,180 lbs (14,627 kg)[1]
	Estimated B(a)P emissions in U.S. Great Lakes Basin: 6 lbs (2.6 kg)[5]
	Estimated B(a)P emissions in Ontario: 0 lbs (0 kg)[5]
Prescribed Burning	Estimated B(a)P emissions in U.S.: 22,300 lbs (10,136 kg)[1]
	Estimated B(a)P emissions in Ontario: 52 lbs (24 kg)[3]
Mobile Sources	Estimated B(a)P emissions in U.S.: 16,060 lbs (7,300 kg)[1,6]
	Estimated B(a)P emissions in Ontario: 1,892 lbs (860 kg)[7,8]
Structure Fires	Estimated B(a)P emissions in U.S. Great Lakes Basin: 290 lbs (132 kg)[9]
	Estimated B(a)P emissions in Ontario: 31 lbs (14 kg)[9]
Agricultural Burning	Estimated B(a)P emissions in U.S. Great Lakes Basin: 4 lbs (2.0 kg)[10]
	Estimated B(a)P emissions in Ontario: 0.7 lbs (0.3 kg)[10]

[1] US EPA 1999 National Emissions Inventory.
[2] Includes forest wildfires, prescribed forest burns, and grasslands wildfires.
[3] Environmental Health Strategies, 2004a.
[4] Environment Canada, Ontario Region, 2003a.
[5] Environmental Health Strategies, 2004b.
[6] Category includes passenger cars, motorcycles, minivans, sport-utility vehicles, light-duty trucks, heavy-duty trucks, and buses, aircraft, commercial marine vessel (CMV), locomotive, farm equipment, and other nonroad engines.
[7] Environment Canada, Ontario Region, 2003b. Emissions are included in Ontario inventory but presented here for comparison to U.S. emissions from motor vehicles.
[8] Category includes passenger cars, motorcycles, minivans, sport-utility vehicles, light-duty trucks, heavy-duty trucks, and buses.
[9] Environmental Health Strategies, 2004c.
[10] Environmental Health Strategies, 2004d.

4.2 OPPORTUNITIES TO ACHIEVE FURTHER REDUCTIONS

This section considers current programs and regulations in place to address sources of B(a)P and assesses potential opportunities for the GLBTS to effect further reductions.

4.2.1 Opportunities with Inventory or Potential Sources

The GLBTS has identified a number of opportunities to effect reductions in B(a)P releases to the Great Lakes Basin. These include reducing or preventing B(a)P emissions from residential wood combustion, scrap tire fires, and residential burning of household waste, and gathering information on emissions from poorly characterized sources.

In addition, further reduction progress could be shown by expanding the workgroup's focus to a broader group of PAHs. PAHs typically occur as a mixture, with similar sources. The primary source of PAH air emissions is incomplete combustion of wood or fuel. Sources of PAHs include the source categories for B(a)P: motor vehicles, residential wood combustion, industrial and commercial combustion, coke ovens.

Note that many sources of B(a)P are also sources of dioxin, and that any opportunities identified to further reduce B(a)P releases are therefore also opportunities to reduce dioxin emissions, and vice versa. The Dioxin and B(a)P Workgroups have held joint meetings to increase the effectiveness of their actions without being redundant.

Residential Wood Combustion

Continued progress is expected as a result of efforts to reduce B(a)P emissions from residential wood combustion, the largest source of B(a)P emissions in the Great Lakes Basin. Ontario has a residential wood combustion program called "Burn it Smart!" that follows a three-pronged approach to reduce emissions: (i) good equipment; (ii) good fuel; and (iii) smart consumer and user. The Burn it Smart Program includes public education workshops and public displays for wood-stove users as well as fact sheets, brochures, videos, and presentations. A survey is planned to assess the impact of wood-stove change-out programs in Ontario, as little information is available to address this issue. US EPA wood stove/fireplace initiatives are also underway. These include development of a Fireplace/Wood Stove website and fact sheet, and potentially additional wood stove change-out programs.

Wax/fiber firelogs are widely used in residential fireplaces, and there is little independent air emissions data from their use. In order to fill this void, US EPA is testing a cross section of different wax/firelogs to determine fuel properties as well as air emissions, including particulate matter, carbon monoxide, B(a)P, and PAHs.

Outdoor wood boilers represent another opportunity to reduce B(a)P emissions from residential wood combustion. A wood boiler is an outdoor wood heating system for homes, businesses, hot tubs, swimming pools, or other structures. The burning takes place in a remote firebox, up to 500 feet away from the structure being heated, typically as an alternative to indoor wood heating. Outdoor wood boilers can generate much smoke and are likely an increasing source of wood smoke emissions, including B(a)P. An ASTM "Task Group on Outdoor Wood-fired Hydronic

Heaters" is looking at a number of issues related to wood boilers, especially development of a testing standard.

Residential Burning of Household Waste

The GLBTS Burn Barrel Subgroup of the Dioxin Workgroup addresses the issue of residential burning of household waste in the Great Lakes Basin. The subgroup has sought to promote programs that target household garbage burning and share information on the subject. A repository of information is posted on the *Great Lakes Trash and Open Burning Website* at http://www.c2p2online.com/main.php3?section=73&doc_id=281. While the subgroup's primary focus is dioxin emissions, efforts to reduce the practice of open burning will have the collateral effect of reducing emissions of other Level 1 substances as well.

Scrap Tire Fires

Both Ontario and the U.S. are involved in programs to abate scrap tire piles and prevent fires, as described in the following paragraphs. Scrap tire fires are estimated to release 6 pounds of B(a)P to the Great Lakes Basin per year (Environmental Health Strategies, 2004b). The GLBTS B(a)P Workgroup will continue to promote and track the results of these programs.

Ninety percent of the scrap tires in the U.S. are located in 11 states, and two of these (Indiana and Pennsylvania) do not have scrap pile abatement programs (Blumenthal, 2004). The Rubber Manufacturers Association (RMA) is working to promote programs in these states. The RMA has given presentations on scrap tire pile abatement and fire prevention, and is developing a peer-reviewed article on how to reduce a tire pile. US EPA Region 5 and the Michigan Department of Environment held a Scrap Tire Cleanup Forum in 2004, and more scrap tire cleanup efforts are being conducted in 2005. As part of the US Scrap Tire Pile Mitigation Support Project, additional fire prevention training courses and pile mapping are planned, and a U.S. Best Practices Guidebook on how to manage scrap tire piles is expected to be completed in 2005.

In Ontario, the Ontario Tire Stewardship (OTS) program plan is under development to address scrap tires, including the province's 5 to 6 million stockpiled scrap tires. In 2005, the final OTS scrap tire diversion program plan, approved by Waste Diversion Ontario (a multi-stakeholder board), was sent to the Ontario Minister of the Environment for final approval. Highlights of the proposed plan include: retailers and scrap tire generators are not charged a pick-up fee; haulers are paid on delivery to approved scrap tire processors; manifest system is instituted to track generation and disposal; processors are paid a processing incentive based on their value-added products; and Ontario scrap tire stockpiles are eliminated five years from the start of the program. Details of the plan and consultations that have been held can be viewed on the OTS website at http://www.ontariotirestewardship.ca/.

Wood Preservation

A study conducted by the University of Toronto entitled "Emission of Creosote Components from Railway Ties" has found that creosote is lost to the environment from new and old railway ties through volatilization, bleeding, and leaching. Ontario is estimated to release 4,532 lbs (2,060 kg) of B(a)P from in-service creosote-treated wood such as railway ties (see Table 5).

The production and use of creosote-treated wood is not likely a B(a)P source with significant opportunities for the GLBTS to effect further reductions. There are currently no wood preservation facilities that use creosote in Ontario (Yang, 2004). In Ontario, a national program called the Strategic Options Process for toxics management is in place for the wood preservation sector, with on-going facility compliance/progress monitoring audits, and a final evaluation planned for 2006. Though not specific to B(a)P, a user guidance document with guidelines for purchasing, storage, in-service use, disposal, and post-use of treated wood is to be distributed and promoted among industrial users in Canada.

In the U.S., in-service preserved wood is not considered a contaminant release source, but rather a reservoir source, and the use of creosote-treated wood is not included in the U.S. inventory for B(a)P. This may be an unaccounted for source of release contributing to B(a)P levels in the environment.

The Utility Solid Waste Activities Group (USWAG) has developed treated wood guidelines setting forth life cycle management principles regarding the proper purchase, use, reuse, and disposal of treated wood. USWAG is committed to promoting these principles within the electric utility industry and has coordinated the development of the guidelines with US EPA. USWAG has also proposed to enter into a "Memorandum of Understanding" (MOU) with US EPA to further promote the principles set out in the guidelines regarding the environmentally sound management of treated wood products (though not specific to B(a)P). The MOU is currently being reviewed by US EPA.

Iron & Steel

There appear to be no significant opportunities for the GLBTS to effect further reductions from the iron and steel sector. With a number of U.S. coke plants closing, a total of 17 coke batteries remain in operation in the U.S. There is growing use in the sector of the much cleaner non-recovery coke oven battery in place of the by-product coke oven battery. Expected B(a)P release trends for the iron and steel sector project steady levels in the short term but declining levels over the long term. The American Coke and Coal Chemicals Institute has been consistently involved in the GLBTS, keeping the B(a)P Workgroup apprised of the status of the iron and steel sector in the U.S. and regulations that affect its emissions.

Relative to a 1988 base year, the iron and steel sector in Ontario has achieved an approximate 73 percent reduction of B(a)P (see Figure 1). Ontario's four integrated steel mills are also on track to meet coke oven PAH targets set out in environmental codes of practice. Reductions are being achieved through rigorous coke oven battery maintenance and by implementation of innovative battery operating practices and procedures. In spite of a major release reduction over the last decade, cokemaking emissions remain the dominant Ontario B(a)P point source, accounting for 21 percent of total B(a)P releases in Ontario in 2003. In 2003, metallurgical coke producers in Ontario employed 11 coke oven batteries and produced 3,035,000 metric tons of coke with a capability utilization rate of 87 percent (CSPA, 2003).

Motor Vehicles

There are a number of current programs and regulations that address motor vehicle emissions in Canada and the U.S. For example, Ontario's *Drive Clean* program continues to be a success in reducing emissions of smog-causing pollutants and other chemicals from vehicle exhausts (Ontario, 2005). Both Canada and the U.S. have emission standards and regulations on gasoline and diesel fuel. While these regulations may target other compounds, such as volatile organic compounds (VOCs) and particulate matter (PM), they are likely to also reduce B(a)P emissions. It does not appear that the GLBTS could add significant value to the current programs and regulations that address motor vehicle emissions.

Poorly Characterized Sources

In 2000, Environment Canada began the GLBTS initiative *Voluntary Stack Testing in Ontario*, to obtain emissions data on poorly characterized sources of GLBTS substances. Environment Canada conducts stack tests and funds the analyses on the condition that the results can be made public. To date, twelve facilities have been tested, including crematoria, pulp and paper, biomedical, and metal industry facilities. The results have shown few emissions of B(a)P from the facilities tested. The information generated has proved useful for inventory development. Environment Canada expects to continue the voluntary stack testing initiative to generate release information on poorly characterized sources.

The B(a)P Workgroup has used information from the *Voluntary Stack Testing in Ontario* initiative and other information to improve B(a)P inventory estimates. For instance, the workgroup has obtained emissions data for petroleum refineries. The data indicate that B(a)P emissions from petroleum refineries in Great Lakes states have decreased substantially. In Ontario, the petroleum refining sector is reporting an annual B(a)P release of less than 44 lbs/yr (20 kg/yr), and additional quantities of B(a)P in generated wastes which undergo further treatment, such as landfarming, or are disposed in a landfill.

In addition, the Dioxin Workgroup has developed issues papers related to uncontrolled combustion sources (Environmental Health Strategies, 2004a-d). These issues papers provide estimates of B(a)P emissions in the Great Lakes Basin that may help to improve current inventories.

Table 8 identifies current programs or regulations and reduction opportunities for known sources of B(a)P.

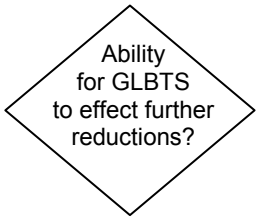
Table 8. Reduction Opportunities for Known Sources of B(a)P.

KNOWN SOURCE	CURRENT REGULATIONS OR PROGRAMS	OPPORTUNITY FOR GLBTS TO ACHIEVE FURTHER REDUCTIONS
Residential Wood Combustion	Canada's Burn it Smart! campaign	Continue to support the campaign
	Wood Stove change-out programs	Continue to support change-out programs
	Fireplace/Wood Stove website	Continue to maintain website
	Wood Stove/Fireplace Community-Based Air Toxic Fact Sheet	Distribute fact sheet
	Wood Stove Media Outreach Package	Distribute outreach package
	Firelog testing	Analyze results
Scrap tire fires	Ontario Tire Stewardship scrap tire diversion program	Continue to support the program
	US Scrap Tire Pile Mitigation Support Project	Continue to support the project
Residential Burning of Household Waste	GLBTS Burn Barrel Subgroup	Continue subgroup efforts
Poorly characterized sources	Voluntary Stack Testing in Ontario	Continue to collect data to identify missing B(a)P sources
	GLBTS Dioxin Workgroup issue papers	Assess estimates for use in B(a)P inventories

4.2.2 Opportunities to Help Characterize Unknown Sources

Air monitoring data do not reflect reductions in B(a)P emissions that have been achieved, according to inventory estimates. One explanation for the absence of a corresponding decrease in the environment is that there are sources of B(a)P contributing to environmental levels that are unaccounted for or are underestimated in current inventories. Inventory improvement work is needed to identify sources missing from current B(a)P inventories for the Great Lakes and Ontario.

4.3 GLBTS OPPORTUNITY ASSESSMENT CONCLUSIONS

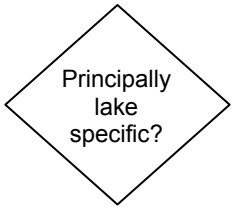


The GLBTS has identified a number of opportunities to effect reductions in B(a)P releases to the Great Lakes Basin. These include reducing or preventing B(a)P emissions from residential wood combustion, scrap tire fires, and residential burning of household waste, and gathering information on emissions from poorly characterized sources. Another important effort is to identify sources of B(a)P emissions missing from current inventories for the Great Lakes Basin.

5.0 MANAGEMENT OUTCOME

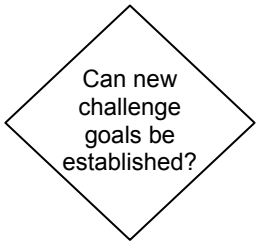
This section presents the final management outcome resulting from the combined environmental and GLBTS opportunity assessment.

5.1 NUMBER OF LAKES IMPACTED



The impact of B(a)P is not specific to any one Great Lake, though concentrations are higher on Lakes Erie and Ontario and at major urban centers, such as Chicago.

5.2 NEW CHALLENGE GOALS



Both Canada and the U.S. have made progress in reducing releases of B(a)P. The reductions achieved in the U.S. have satisfied the U.S. challenge goal. However, despite the reported 77 percent reduction in B(a)P emissions in the Great Lakes Basin, the lack of an overall improvement in air quality raises the possibility there may be unaccounted for sources of B(a)P.

It is not practical to establish new challenge goals at this time. To propose new reduction targets, much effort would be required to develop current and baseline inventories that provide accurate estimates of all potential sources of B(a)P. The GLBTS B(a)P Workgroup continues to

seek reductions in B(a)P emissions, as possible, and to identify additional sources of B(a)P release that contribute to environmental levels in the Great Lakes Basin. Setting new challenge goals would not accelerate the pace of workgroup efforts, and could detract from them.

5.3 FINAL MANAGEMENT OUTCOME

The final management outcome for B(a)P is continued active Level 1 status with reassessment in 2008 by the GLBTS. The B(a)P Workgroup will continue to pursue reduction actions for B(a)P as a Level 1 substance. In particular, the workgroup will continue the "Burn-it-Smart" campaign, wood stove change-out projects, firelog testing, and scrap tire programs. The workgroup will begin to address wood boilers as a source of B(a)P. For any major sector that remains a significant contributor, a sector subgroup will be established.

In addition to pursuing reductions, the workgroup will also gather information to improve current inventories for B(a)P. This includes identifying significant sources that have not been adequately accounted for in the inventory, as well as identifying any source categories that have achieved "Virtual Elimination" – as seems to be the case for petroleum refineries. Source apportionment methods may be used to identify missing sources. The B(a)P Workgroup will form an emission inventory subgroup for this task. Because inventory issues have been identified for other GLBTS workgroups as well, the inventory subgroup may be one subgroup that addresses emission inventory issues for all GLBTS substances.

The B(a)P Workgroup will expand its focus to a larger group of PAHs. Inventories have been developed for PAHs on the GLBTS Level 2 list, and little additional work would be required to show reduction progress for this group of compounds.

A reassessment will be undertaken in 2008 using the *General Framework to Assess Management of GLBTS Level 1 Substances*.

6.0 REFERENCES

American Petroleum Institute (API). Letter from Roger Claff, Senior Environmental Scientist, API, to Steven Rosenthal, US EPA Region 5, dated November 9, 2001.

Blumenthal, M. 2004. Presentation at Great Lakes Binational Toxics Strategy Hexachlorobenzene/Benzo(a)pyrene Workgroup Meeting, November 30, 2004, Chicago.

Boyd, D., Ontario Ministry of the Environment. 2005. Personal communication.

Brubaker, Jr., W.W. and Hites, R.A. 1998. OH reaction kinetics of gas-phase a- and g-hexachlorocyclohexane and hexachlorobenzene. *Environ. Sci. Technol*. 32:766-769.

Buehler, S. et al. 2004. Causes of Variability in Pesticide and PCB Concentrations in Air Near the Great Lakes. *Enviro. Sci. Technol*. 38: 414-422.

CCME. 1999. Canadian Council of Ministers of the Environment. 1999 Canadian Environmental Quality Guidelines. Winnipeg, Manitoba.

CSPA. 2003. Canadian Steel Producers' Association, PAH Environmental Best Practice Manual for Coke Producers, 2003 annual report.

Curren, K. and T. Dann. 2004. Monitoring of Persistent Toxic Substances in the Ontario -- Great Lakes Basin (1996 - 2003). Environment Canada, Analysis and Air Quality Division, Environmental Technology Centre, unpublished report.

Dann, T. Environment Canada, Analysis and Air Quality Division. 2004.

El-Shaarawi, A.H. and B. Ventressca. 1998. SAS-Based Program for Trend Analysis of Niagara River Toxic Contaminants Monitoring Data, March 1998.

Environment Canada, Ontario Region. 2003a. Household waste estimate for 2002. Emission factor used based on US EPA 1997 Evaluation of Emissions from the Open Burning of Household Wastes in Barrels, EPA report: EPA 600-R-97-134a; and quantities of waste burned in 2000 from "Dioxin/Furan Emissions from On-site Residential Waste Combustion in Canada", February 2003, prepared for CCME, by Gartner Lee Ltd., and 2002 waste quantities estimated using Statistics Canada population data.

Environment Canada, Ontario Region. 2003b. Toxics Emissions from On-Road Motor Vehicles in Ontario, Draft report March 18, 2003.

Environmental Health Strategies. 2004a. Toxic Emissions from Wildfires and Prescribed Burning, Issue Paper, November 19, 2004, prepared for Environment Canada by Environmental Health Strategies.

Environmental Health Strategies. 2004b. Toxic Emissions from Tire Fires, Issue Paper, March 31, 2004, prepared for Environment Canada by Environmental Health Strategies.

Environmental Health Strategies. 2004c. Toxic Emissions from Structural Fires, Issue Paper, March 31, 2004, prepared for Environment Canada by Environmental Health Strategies.

Environmental Health Strategies. 2004d. Toxic Emissions from Agricultural Burning, Issue Paper, March 31, 2004, prepared for Environment Canada by Environmental Health Strategies.

Health Canada. 1998. Persistent Environmental Contaminants and the Great Lakes Basin Population: An Exposure Assessment. Health Canada, Environmental Health Directorate. ISBN 0662-26738-9.

Kay, R.T., Arnold, T.L., Cannon, W.F., Graham, D., Morton, E., Bienert, R. 2003. Concentrations of Polynuclear Aromatic Hydrocarbons and Inorganic Constituents in Ambient Surface Soils, Chicago, Illinois: 2001-02. Water-Resources investigations Report 03-4105, U.S. Geological Survey, Urbana, IL.

MOE. 1993. Ontario Ministry of the Environment, Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. August 1993, ISBN 0-7729-9248-7.

Ontario. 2005. Ontario Drive Clean Program. Access: http://www.driveclean.com/main/.

Persaud, D., Jaagumagi, R., Hayton, A. 1993. Guidelines for the protection and management of aquatic sediment quality in Ontario. Water Resources Branch, Ontario Ministry of the Environment, Toronto, 27 pp.

Richman, L., Ontario Ministry of the Environment. 2005. Personal communication.

US EPA. 2005a. Integrated Risk Information System. Access: http://www.epa.gov/iris/subst/0136.htm.

US EPA. 2005b. National Listing of Fish Advisories (NLFA) (Year 2003 data). US Environmental Protection Agency. Access: http://www.epa.gov/ost/fish/advisories/index.html.

US EPA. 2005c. National Fish Tissue Study. US Environmental Protection Agency. Access: http://epa.gov/waterscience/fishstudy/ .

US EPA 2004a. Great Lakes Binational Toxics Strategy 2004 Draft Progress Report. US Environmental Protection Agency, Great Lakes National Program Office. Access: http://www.epa.gov/glnpo/bns/reports/2004progress/index.html.

US EPA 2004b. National Fish Tissue Study Year 1 and Year 2 data provided by US EPA, personal communication.

US EPA, 2002. National Recommended Water Quality Criteria: 2002. EPA-822-R-02-047 (65FR66443).

US EPA. 2000. Guidance for Assessing Chemical Contaminant Data for Use In Fish Advisories. US Environmental Protection Agency. Access: http://www.epa.gov/ost/fishadvice/volume2/.

US EPA 1999. US EPA 1999 National Emissions Inventory.

Waltho, J., Environment Canada. 2005. Personal communication.

Yang, C., Environment Canada. 2004. Presentation at Great Lakes Binational Toxics Strategy HCB/B(a)P Workgroup Meeting, November 30, 2004.

This page left intentionally blank.

APPENDIX A:

GENERAL FRAMEWORK TO ASSESS MANAGEMENT OF GLBTS LEVEL 1 SUBSTANCES: BACKGROUND, OBJECTIVES, AND DOCUMENTATION

This page left intentionally blank.

GENERAL FRAMEWORK TO ASSESS MANAGEMENT OF GLBTS LEVEL 1 SUBSTANCES: BACKGROUND, OBJECTIVES, AND DOCUMENTATION

BACKGROUND

Over the past thirty years, the governments of Canada and the United States have joined together with industries, citizen groups, and other stakeholders in a concerted effort to identify and eliminate threats to the health of the Great Lakes ecosystem resulting from the use and release of persistent toxic substances. A major step in this process was the enactment of the *Revised Great Lakes Water Quality Agreement (GLWQA) of 1978* which embraced, for the first time, a philosophy of "virtual elimination" of persistent toxic substances from the Great Lakes. In 1987, the GLWQA was amended, establishing Lakewide Management Plans (LaMPs) as a mechanism for identifying and eliminating any and all "critical pollutants" that pose risks to humans and aquatic life. In 1994, the International Joint Commission's *Seventh Biennial Report* under the GLWQA called for a coordinated binational strategy to "stop the input of persistent toxic substances into the Great Lakes environment." This led to the signing of the *Great Lakes Binational Toxics Strategy* (GLBTS, or Strategy) in 1997. The Strategy specifies Level 1 substances, each targeted for virtual elimination and each with its own specific challenge goals, along with Level 2 substances targeted for pollution prevention. The substances were selected on the basis of their previous nomination to lists relevant to the pollution of the Great Lakes Basin, and the final list was the result of agreement on the nomination from the two countries. The specific reduction challenges for each substance include individual challenge goals for each country, within a time frame that expires in 2006.

Significant progress has been made toward achieving the Strategy's challenge goals. As 2006 approaches, an analysis of progress and determination of next steps is needed to respond to the mandate set forth in the Strategy. The purpose in developing the *General Framework to Assess Management of GLBTS Level 1 Substances* is to provide a tool to assist the Parties (Environment Canada and US EPA) and stakeholders in conducting a transparent process to assess the Level 1 substances.

OBJECTIVE

The framework presents a logical flow diagram for evaluating progress and the need for further action by the GLBTS on the Level 1 substances in order to meet the following objective:

Evaluate the management of GLBTS Level 1 substances with the following potential outcomes:

1) **Active Level 1 Status & Periodic Reassessment by GLBTS**
2) **Consider Submission to BEC[13] for New Challenge Goals**
3) **Engage LaMP Process**

[13] The Binational Executive Committee (BEC) is charged with coordinating implementation of the binational aspects of the 1987 Great Lakes Water Quality Agreement, including the GLBTS. The BEC is co-chaired by EC and US EPA and includes representatives from the Great Lakes states and the Province of Ontario, as well as other federal agencies in Canada and the U.S.

4) **Suspend GLBTS Workgroup Activities. Where warranted, refer to another program and/or participate in other fora. Periodic Reassessment by GLBTS, until Parties determine substance has been virtually eliminated.**

Additional outcomes that may result from the framework are:

- **Recommend benchmark or criteria development as a high priority; and**
- **Recommend additional environmental monitoring as a high priority.**

The framework is intended to serve as a guide in determining the appropriate management outcome(s) for the Level 1 substances: mercury, polychlorinated biphenyls (PCBs), dioxins and furans, hexachlorobenzene (HCB), benzo(a)pyrene (B(a)P), octachlorostyrene (OCS), alkyl-lead, and five cancelled pesticides: chlordane, aldrin/dieldrin, DDT, mirex, and toxaphene. The framework is not intended to specify details of how a Level 1 substance should be addressed once a management outcome is determined.

STRUCTURE OF THE FRAMEWORK

The framework is set up in a hierarchical fashion to allow efficiencies in the decision process. The hierarchy of the framework is to first consider progress toward the challenge goals committed to in the Strategy, then to conduct an environmental analysis and finally, a GLBTS management assessment which leads to various potential management outcomes for a substance.

The environmental analysis (depicted in green) and the GLBTS management assessment (depicted in blue) comprise the two main parts of the framework. The environmental analysis considers available Canadian and U.S. monitoring data and established human health or ecological criteria as the primary basis for an objective evaluation of a substance's impact on the Basin. For substances lacking sufficient risk-based criteria or environmental monitoring data, the framework recommends the development of benchmarks or criteria and additional monitoring as a high priority. While the environmental analysis places emphasis on good monitoring data, evidence of use, release, exposure, or precautionary concerns may also be considered.

If the environmental analysis concludes that there is no basis for concern, GLBTS workgroup activities may be suspended, with periodic reassessment of the substance until the Parties determine that the substance has been virtually eliminated. If, on the other hand, the environmental analysis concludes that there is a reason for concern, the GLBTS management assessment evaluates the ability for the GLBTS to effect further improvements in and out of the Basin. The GLBTS management assessment also considers whether the impact of a substance is basinwide or restricted to a single lake. In cases where the GLBTS can effect further reductions, consideration will be given as to whether new Strategy challenge goals can be established. Virtual elimination is an underlying tenet of the Strategy and should be kept in mind throughout the assessment process.

The GLBTS management assessment can result in a number of potential management outcomes; the outcomes provided in the framework allow a substance to remain in active Level 1 status or GLBTS workgroup activities to be suspended. The outcomes also recognize that it may be appropriate to more actively involve a LaMP process, to refer a substance to another program, to represent GLBTS interests in other fora (e.g., international programs), or to consider proposing new challenge goals. All outcomes include a periodic reassessment by the GLBTS (approximately every two years).

While it is recognized that the Parties have an ongoing responsibility to promote GLBTS interests in other arenas, a potential outcome of the framework is to recommend referral to another program and/or GLBTS representation in other fora. In the GLBTS framework, this option is presented when there is no evidence of Basin effects, or when the GLBTS cannot effect further significant reductions on its own, but can advocate substance reductions in other programs and in international fora.

It should be noted that, in using the framework to conduct assessments for the Level 1 substances, it may not be possible to definitively answer "YES" or "NO" to all questions. It is not necessary to have a definitive answer to proceed in the framework. For example, in assessing whether there is environmental or health data to assess the impact of the substance in the Basin, it may be determined that, while additional data would be helpful, there is some data on releases and environmental presence in certain media with which to assess the status of the substance. In this case, judgment is needed to decide whether these data are sufficient to proceed along the "YES" arrow or whether the available data are not adequate and the analysis should proceed along the "NO" arrow, placing the substance on a high priority list for monitoring. As a general guide, the framework allows flexibility and judgment in interpreting environmental data and in determining the most appropriate management outcome(s).

Each decision node, or shape, in the framework is illustrated below along with a brief explanation that describes, in further detail, the question to be assessed.

GLBTS Level 1 Substances

All 12 Level 1 substances will be assessed.

Have the challenge goals for the substance been met?

The first question to consider in assessing the GLBTS status and future management of a Level 1 substance is whether the challenge goals agreed to in the Strategy have been met. The answer to this question informs the subsequent assessment in many ways, not only indicating progress, but also revealing issues associated with the ability to pursue further reductions. Progress toward the U.S. and Canadian goals will be considered jointly. Challenge goals will be evaluated with the best data presently available. Note that some challenge goals target "releases" of a substance while others target its "use". As a result, different types of data may be required to evaluate challenge goal status (e.g., "use" data vs. environmental "release" data). The framework continues with both the environmental analysis and GLBTS management assessment, notwithstanding the status of the challenge goals.

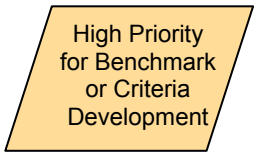
ENVIRONMENTAL ANALYSIS

Characteristics of acceptable monitoring data to assess the temporal, spatial, and population representativeness of a substance in the Great Lakes Basin ecosystem include (but are not limited to) basin-specific measures in water, air, sediment, soil, indoor environments (e.g., dust), fish, biota, or human biological samples. If necessary, use or release data may be used as surrogates (e.g., in the case of alkyl-lead).

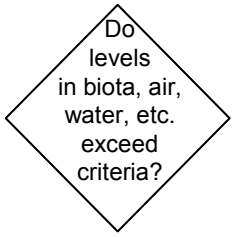
"What gets measured gets managed." Substances entering this box will be recommended as a high priority for monitoring to the Parties. The intent is that these GLBTS substances will be considered by a wide range of government or private agencies when they make decisions regarding which analytes to monitor in the environment. As sufficient monitoring data is developed, substances will be re-evaluated.

Relevant criteria include, but are not limited to:

- Water quality criteria
- Fish tissue concentrations
- Ambient or indoor air standards
- Sediment or soil standards
- Limits based on reference doses
- Health-based standards for human biota measurements



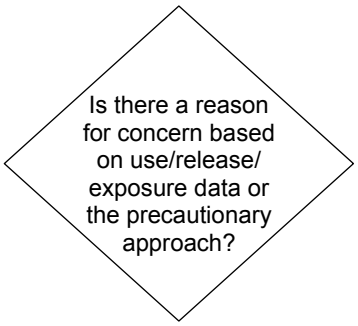
If there are no criteria against which to evaluate current levels, the GLBTS will consider whether there is a need for the Parties to recommend the development of human health or ecological criteria. This box effectively creates a GLBTS list of substances that are in need of human health or ecological criteria with which to identify exceedances in the environment.



As the framework is intended to be flexible in its implementation, the choice of criteria to use in answering this question may vary. For example, the most strict criteria in one or more media may be used to evaluate environmental levels.

If there are no criteria, or if current levels do not exceed criteria, this box considers whether there is a decreasing trend. A decreasing trend could be defined as a statistically significant negative slope. If the trend is decreasing, the substance is evaluated for evidence of concern based on use, release, exposure, or the precautionary approach. If a decreasing trend cannot be established, then the substance moves directly to the GLBTS management assessment to determine the ability of the GLBTS to effect further reductions.

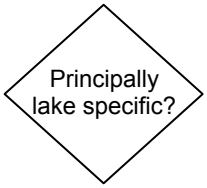
* Note that, in the event that there are established criteria and the GLBTS substance is below those criteria but not decreasing in trend, further analyses may be required to estimate when criteria might be exceeded.



In cases where sufficient monitoring data is not available, or where environmental trends are decreasing and criteria have either not been established or are not being exceeded, the relevant question is whether there is evidence of Basin effects based on documented use, release, or exposure data, or from a precautionary point of view. An example of a precautionary point of view would be documented evidence of significant impact in another geographic location with the same sources and use patterns as in the Basin, or because the effects of a pollutant would be significant by the time it was able to be measured through monitoring.

GLBTS MANAGEMENT ASSESSMENT

Answering this question involves an accelerated version of the first three steps of the GLBTS 4-step process,[14] looking at sources and current programs and regulations to see where the reduction opportunities lie. Part of the assessment will involve consideration of whether the reduction opportunities will be significant enough to merit the effort.



Based on a joint GLBTS-LaMP determination that the impact of a substance is restricted to a single lake, the appropriate LaMP will be engaged for coordination of leadership for reduction actions to be undertaken by the responsible organizations.

The GLBTS will assess the practicality of setting forth new challenge goals.

[14] The GLBTS four-step process to work toward virtual elimination is: 1) Information gathering; 2) Analyze current regulations, initiatives, and programs which manage or control substances; 3) Identify cost-effective options to achieve further reductions; and 4) Implement actions to work toward the goal of virtual elimination.

GLBTS MANAGEMENT OUTCOMES

Active Level 1 Status & Periodic Reassessment by GLBTS

The substance will continue as a Level 1 with reduction actions addressed by the appropriate process and with periodic reassessment, approximately every two years, using the *General Framework to Assess Management of GLBTS Level 1 Substances*.

Consider Submission to BEC for New Challenge Goals

The GLBTS will consider recommending new challenge goals to BEC. The justification for new challenge goals will incorporate the findings of the framework analysis and will include assessment of the desired environmental improvement and feasibility. If the GLBTS decides to propose new challenge goals, the recommendation to BEC will include a reduction percentage, reduction timeline, and baseline for the proposed new challenge goals.

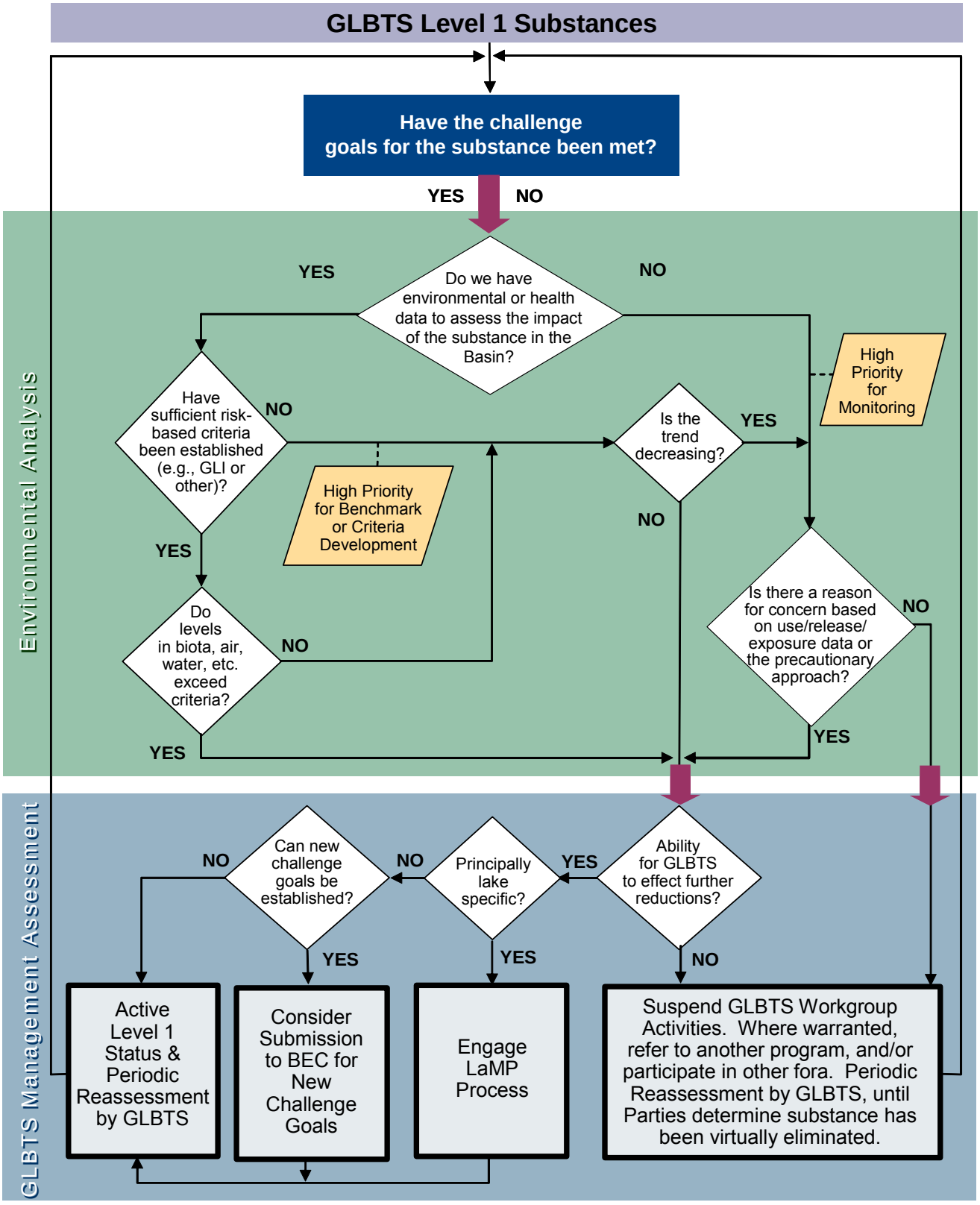
Engage LaMP Process

For substances whose impact is lake-specific, the appropriate LaMP will be engaged to coordinate substance reduction activities with continued support from the GLBTS, recognizing the limited direct implementation capacity of the LaMPs. It is understood that much of the actual implementation would be carried out by the agencies with responsibility to address these substances. A joint review of progress would be undertaken periodically.

Suspend GLBTS Workgroup Activities. Where warranted, refer to another program, and/or participate in other fora. Periodic Reassessment by GLBTS, until Parties determine substance has been virtually eliminated.

In the event that the GLBTS is not able to effect further reductions, or there is no evidence of Basin effects, GLBTS workgroup activities will be suspended. Where warranted, a recommendation will be made to a) refer reduction efforts for the substance to another program, and/or b) represent GLBTS interests in other fora (e.g., Commission for Environmental Cooperation, United Nations Environment Programme). There will be no ongoing workgroup involvement with these substances, though each one will undergo periodic reassessment, approximately every two years, using the *General Framework to Assess Management of GLBTS Level 1 Substances*, until the Parties determine that virtual elimination has been reached.

General Framework to Assess Management of GLBTS Level 1 Substances



APPENDIX B:

ENVIRONMENTAL/HEALTH DATA

This page left intentionally blank.

B.1 SAMPLING AND ANALYTICAL METHODOLOGY FOR ENVIRONMENT CANADA SCREENING LEVEL SURVEYS OF SEDIMENT QUALITY IN CANADIAN TRIBUTARIES TO LAKES ERIE AND ONTARIO

Figure B-1 shows the tributaries sampled in the surveys conducted in the lower Great Lakes for the 2001-2003 period. Surficial (top 1-2 cm) sediments were collected from one or more depositional reaches of each tributary, upstream of its mouth, using either a stainless steel spoon (shallow water depth, low current) or a petite Ponar Grab sampler. The sampling program was based on the Guidelines for Collecting and Processing Samples of Stream Bed Sediment for Analysis of Trace Elements and Organic Contaminants, developed by the United States Geological Survey for the U.S. National Water-Quality Assessment Program (Sheldon and Capel, 1994). Sites represented different in-stream locations (eg., pools, different depths of water, behind dams). Samples from all sites were composited, sieved and further homogenized and then collected into 250 ml glass jars with Teflon lined screw caps for organochlorine (OC) and polyaromatic hydrocarbon (PAH) analyses. Samples for metal analysis were collected into 125 ml polyethylene jars. Organics were analyzed by Maxxam Analytics Inc. After accelerated solvent extraction, OCs were analyzed by gas chromatography/dual column electron capture (GC/ECD). PAH samples were extracted by sonication, the extracts concentrated, and analyzed by GC/MS. Results are reported on a dry weight basis. Caduceon Environmental Laboratories (Ottawa, ON) performed the metal analysis (including mercury) on freeze-dried samples using *aqua regia* digestion.

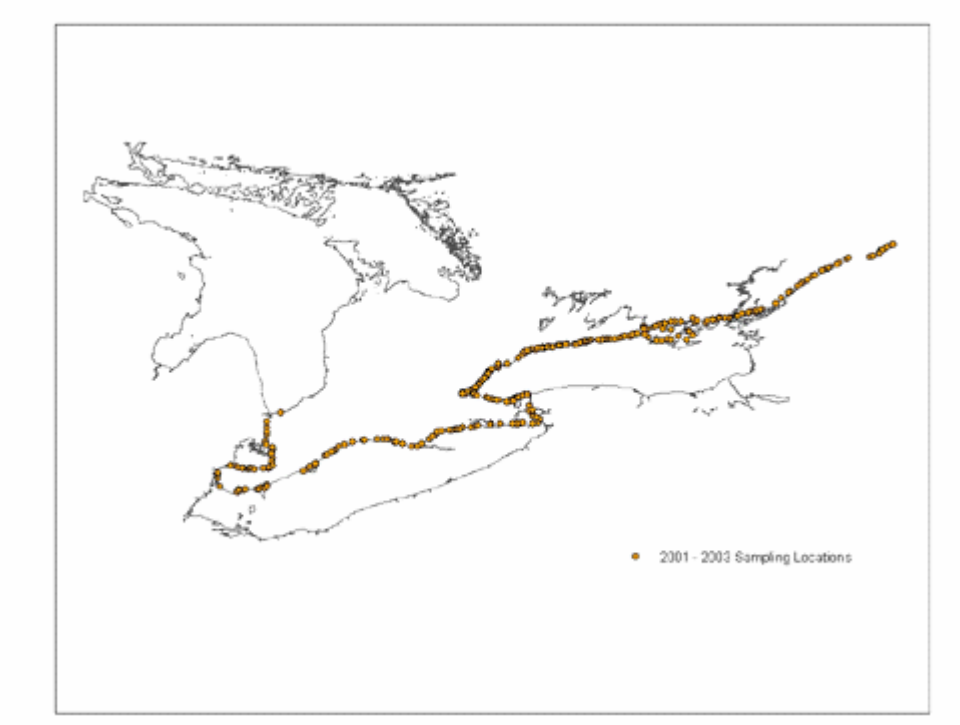


Figure B-1. Sampling Locations for the Lower Great Lakes.

B.2 ST. CLAIR-DETROIT RIVER CORRIDOR – UPSTREAM/DOWNSTREAM WATER QUALITY MONITORING

Objectives and Monitoring Strategy

A whole-water monitoring program for the St. Clair and Detroit Rivers was initiated, in 2001, to assess a wide range of organic and inorganic contaminants. This monitoring effort is a component of Environment Canada's Great Lakes Surveillance and Connecting Channels program and supports Remedial Action Plans (RAPs) for the restoration of beneficial uses of the St. Clair and Detroit Rivers and Lakewide Management Plans (LAMPs) for Lake Erie. The intent is to identify contaminants of concern and to characterize their concentrations with a primary focus on upstream-downstream differences in concentration, compliance with relevant water quality guidelines, values, criteria, and/or objectives, and, where applicable, to provide supporting data to assess the effectiveness of remedial actions and to determine whether improvements in water quality are being achieved.

The monitoring strategy adopted was to select a reference site for each river that was in the main headwater channel, upstream of all riverine inputs. The downstream sampling sites, which are intended to track and be responsive to changing toxic contaminant concentrations, are located below of all major contaminant inputs, in nearshore channels, off the east and west shores of the St. Clair and Detroit Rivers.

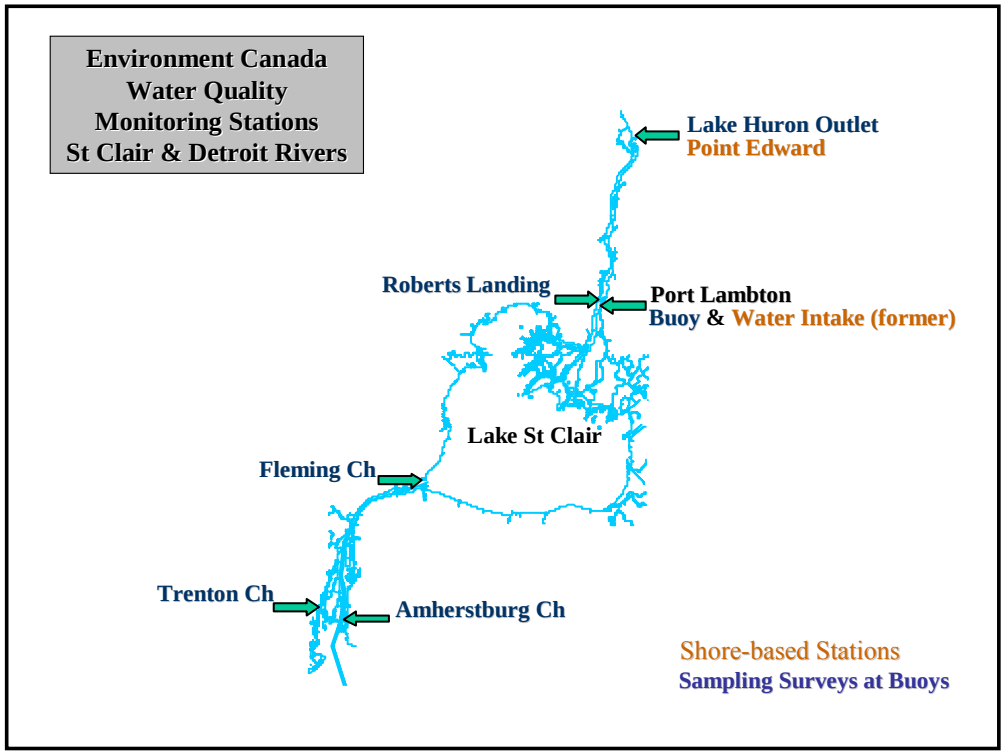


Figure B-2. Water Quality Monitoring Locations in the St. Clair - Detroit River Corridor

In order to realize the goal of providing valid riverine data several the following approaches has been adopted. Clean field techniques are being used and, thus, issues of relating to sample contamination have been effectively mitigated. Collection of large volume samples (150) has provided a capability for ultra low level analyses, for a wide range of contaminants. Therefore, assessing the data against the most sensitive guidelines is being achieved. Back-up samplers are deployed at each site to ensure that samples are being collected. Combined, the data collection objectives are being met.

Methods

The St. Clair – Detroit River Corridor Water Quality Monitoring Program includes extensive quality assurance/control procedures. Large volume samples are collected to achieve appropriate sensitivity. The analytical procedures incorporate clean techniques in combination with the most sensitive and selective instrumentation available. A comprehensive quality assurance program is in place with a large number of surrogate spikes employed to validate the data. The monitoring and analytical procedures are very consistent, and data are generated from one of the most competent labs in North America.

Samples for organic contaminant analyses are collected with submersible samplers that have an internal computer-controlled pump/flow metering system that allows the operator to set the desired sample process rate and total volume to be sampled. Sample water contact with the instruments pump and flow metering systems occurs after processing, and therefore, risks of sample contamination are mitigated. The suspended sediment fraction is collected on stacked filter sets consisting of 3 μm and 0.7 μm glass fibre filters, whereas contaminants associated with the aqueous phase or filtrate are adsorbed onto XAD-2 resin. Sample water is drawn at modest flow rates (100 to 150 $mL \cdot min^{-1}$) through the filter sets and then through the column, which contained 85 mL of XAD-2 resin. The resulting bed load flow rate factor is less than 2, and thus, the extraction efficiency is optimized. A total sample volume of 150 L was established to provide sufficient sample for the required analyses and to mitigate the risk analyte breakthrough.

B.3 NIAGARA RIVER UPSTREAM/DOWNSTREAM MONITORING PROGRAM AND THE ST. LAWRENCE RIVER MONITORING PROGRAM

Niagara River Upstream/Downstream Monitoring Program Background

The Niagara River has a significant influence on Lake Ontario. It is responsible for more than 83% of the total tributary inflow to Lake Ontario (Eadie and Robertson 1976), 85% of the total input water budget, and about 50% of all incoming fine-grained sediment (Kemp and Harper 1976). Because of this influence, Environment Canada established a monitoring station in 1975 at the mouth of the Niagara River at Niagara-on-the-Lake to estimate the annual chemical loads and changes/trends in these loads from the river to Lake Ontario. Love Canal, and the publication of numerous reports on the magnitude of the hazardous waste site problem on the U.S. side of the river in the late 1970s, further heightened Environment Canada's concern about the input of chemicals to the river and, subsequently, to Lake Ontario. A second station was established at the head of the Niagara River at Fort Erie in October 1983, to estimate the loads of chemicals to the river from Lake Erie.

This Upstream/Downstream Program, as it became known, was a key component of the Niagara River Long Term Monitoring Plan recommended by the Niagara River Toxics Committee (NRTC 1984). It was formally incorporated into the Niagara River Declaration of Intent (DOI) signed by the Four Parties, Environment Canada, the United States Environmental Protection Agency (Region II), the Ontario Ministry of the Environment, and New York State Department of Environmental Conservation, in February 1987. Thus, what had begun as an Environment Canada initiative became a component of the Niagara River Toxics Management Plan (NRTMP). The overall goal of the NRTMP is to achieve significant reductions of toxic chemical pollutants in the Niagara River.

St. Lawrence River Monitoring Program Background

As part of the commitment made under the Great Lakes Water Quality Agreement, originally signed between Canada and the United States in 1972, Environment Canada began sampling the outlet from Lake Ontario at the Wolfe Island station in the St. Lawrence River in 1976. The data from this program also serves as the upstream comparison for programs conducted further downstream in the river. The St. Lawrence River Monitoring Program mimics the program conducted in the Niagara River with the exception of the sampling frequency. The Niagara River is sampled for organic contaminants on a biweekly schedule vs. every four weeks for the St. Lawrence River.

Sampling & Analytical Methodology

The Niagara River Upstream/Downstream Program measures the concentrations of trace organic contaminants and trace metals in water and suspended solids at the head of the Niagara River at Fort Erie and at the mouth of the River at Niagara-on-the-Lake. Over the eleven-year period 1986/87 – 1996/97, sampling was conducted weekly. Since that time, the sampling frequency has been changed to biweekly. Sampling times at the two stations are offset by approximately 15-18 hours to allow for the travel time of water between the head and mouth of the river.

Large-volume, 24-hour time-integrated dissolved phase and particulate phase water samples for organic contaminants are collected using a submersible pump, intake line, and Westfalia centrifuge assembly connected to a Goulden Large Sample Extractor. This technique is essentially a continuous liquid/liquid extraction. Suspended sediment is collected from the centrifuge, extracted and analysed according to documented procedures. Since the program analyses two distinct matrixes (dissolved phase and suspended sediment), the concentration in the whole water is determined by calculation.

Sampling procedures and analytical methodologies for the Upstream/Downstream Program have been documented elsewhere (NRSP 2003; NRAP 2000; NRAP 1992; NRSP 1995; Data Interpretation Group 1997; Data Interpretation Group 1999). These protocols, developed and agreed to by the Four Parties, include the requirement for regular audits of Environment Canada field and laboratory operations. The purpose of these audits is to ensure that these protocols are being followed by Environment Canada's field and laboratory staff. Four Party audits were conducted in 1988, 1991, 1993, 1997, and most recently in 2000. In each case, the audit teams concluded that the procedures generally adhered to those described in the sampling and analytical protocol documents and, therefore, should result in generation of data of acceptable quality.

While the St. Lawrence River Program does not undergo any formal audits, it should be noted that the sampling and analytical methodology are identical to the Niagara River program and by extension the data is also of comparable quality.

It is important to note that all analysis over the duration of these programs has been conducted by the same laboratory under the direction of the National Laboratory for Environmental Testing (NLET). NLET is accredited by the Standards Council of Canada (SCC) and is routinely audited by the Canadian Association of Environmental Analytical Laboratories (CAEAL).